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A GUIDE TO THE SHALLOW-WATER ECHINODERMATA OF THE TEXAS COAST

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INTRODUCTION

Guide books help scientists identify specimens for use in laboratory and field studies and serve as teaching resources for zoology and marine biology classes. This guide is designed for identification of species occurring in Texas waters of less than 30 m depth and includes off-shore calcareous banks and reefs.

There have been several general works on the faunal regions of the Gulf of Mexico or Texas coast (Gunter 1950, Hedgpeth 1953, Hildebrand 1954, Harper 1970, Defenbaugh 1976, Pequegnat 1983, Britton and Morton 1989). Whitten et al. (1950) examined the jetties. Laguna Madre and associated bays have been surveyed by Simmons (1957), Breuer (1957, 1962), Parker (1959) and Holland et al. (1973). Several works, mainly theses, (Hulings 1955, Burke 1974, 1974a, Shirley 1974, Dubois 1975) looked at the echinoderm fauna of very specific regions, such as the Flower Garden reefs. Clark and Downey (1992), Downey (1973) and Mukai (1974) produced specific works on the asteroids of this region. Miller and Pawson (1984) covered the holothuroids of the Gulf of Mexico, but most of their material came from Florida. Hendler et al. (1995) produced a guide for Florida, but it lacks keys to species and is missing some species from Texas.

The northern Gulf of Mexico is a transitional zone from Caribbean to subtropical and temperate conditions. The Texas coast and off-shore banks represent a diverse gradient of temperature, salinity and habitat types (Hedgpeth 1953, Parker 1955, Breuer 1957, Simmons 1957, Collier et al. 1958, Temple et al. 1977, Temple and Martin 1979,

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Gallaway 1981, Shew et al. 1981, Armstrong 1987, Britton and Morton 1989). Temperatures fluctuate between 10°C and 30°C. Salinity may range from the teens to over 50‰ in coastal bays and lagoons. Habitat types include grass beds, coral reefs, calcareous banks, rock jetties and sand-mud bottoms.

The faunal affinity of most echinoderms along the Texas coast is the Caribbean region (Pomory 1990). Echinoderm fauna are probably dispersing into local waters on summer currents that flow south to north (Temple and Martin 1979). The freshwater outflow of the Mississippi River and the Florida Everglades, the direction of the Gulf Stream, and the tropical environment of the southern tip of Florida may be effective barriers to near-shore echinoderm dispersal and migration from the Carolinian and more northern areas of the U. S. east coast. This guide includes keys and descriptions for 5 asteroids, 11 echinoids, 14 holothuroids and 19 ophiuroids.

METHODS

Specimens were obtained from collections of Pan American University, Texas A&I University, Texas A&M University Biology Department and the Texas A&M University Oceanography Department. Collections from the surf zone and jetties at Galveston, Port Aransas, Port Mansfield and Brazos-Santiago were made by hand. Specimens not found in collections from Texas, but reported for the area, were obtained from the U. S. National Museum for descriptive and illustrative purposes. Material collected live was preserved, first in 95% ethanol for 3 d, and then transferred to 70% ethanol for long term storage. Formalin was not used at any stage.

Whole and denuded echinoid examples were used for descriptions and illustrations. Holothuroids were dissected by making an incision along the entire side of the body so the calcareous ring and gonads could be observed. Small pieces of dermis from the middle and anterior end of the body, several podia and a tentacle were removed for ossicle preparation. The podia and tentacle were placed on slides with a drop of bleach and allowed to dissolve. Dermis pieces were placed, outside surface face down, on a slide with a drop or two of bleach. After 1 min, the tissue was transferred to a new slide

with bleach for an additional minute. The slides were then examined under a compound microscope. Illustrations were drawn by the author based on preserved specimens.

The systematic accounts and references in each are in alphabetical, rather than taxonomic, order to aid in cross-referencing material. Terms used in the descriptions and keys to the species are defined in the glossary at the end of the guide.

SYSTEMATIC ACCOUNTS

Class Asteroidea

The Asteroidea are stellate echinoderms that have the disk and arms solidly fused together with no distinct margin separating the disk surface from the arm surface. The ambulacral grooves are open along the oral surface of the arms. The madreporite is aboral and placed somewhere on the disk region, as is the anus. The aboral surface may have paxillae, papullae, granules, pedicellaria, spines or a combination of the above. The arms may have a border of superomarginal plates; below which lie the inferomarginal plates. The very tips of the arms have an ocular plate. Adambulacral and ambulacral plates form the structure of the oral side of the arms medial to the inferomarginal plates. The podia may have zero, one or two ampullae and may or may not have suckers on the tips. Relatively few asteroids are found in Texas shallow waters compared to the Caribbean. They are mostly found in soft-bottom areas. The deeper water regions of the northern Gulf of Mexico have a more diverse asteroid fauna.

Classification

Phylum Echinodermata

Subphylum Asterozoa

Class Asteroidea

Order Paxillosida

Family Astropectinidae

Astropecten articulatus (Say, 1825)

Astropecten duplicatus Gray, 1840

Family Luidiidae

Luidia alternata (Say, 1825)

Luidia clathrata (Say, 1825)

Order Valvatida

Family Ophidiasteridae

Ophidiaster guildingii Gray, 1840

Key to the Asteroidea

1a. Arms round to oval with plates and papullae in regular columns along arms. Surface of arms and disk covered with small granules...*Ophidiaster guildingii*.

1b. Arms flattened and paxillate 2

2a. Superomarginal plates absent, no raised wall around edge of disk and arms 3

2b. Superomarginal plates distinctly enlarged forming raised wall around edge of disk and arms 4

3a. Paxillae squared, larger near edge of arms. Color gray-blue, sometimes darker along middle of arms, no banding…*Luidia clathrata*.

3b. Paxillae circular, some on edge of arms with central spines. Color cream-tan with brown banding on arms and disk…*Luidia alternata alternata*.

4a. Paxillae with granulose or rounded projections. Superomarginal plates rarely with short spines. Paxillae area dark purple or red-purple in life. Ratio of R (mm): number of superomarginal plates along one side of arm usually < 2…*Astropecten articulatus*.

4b. Paxillae with spinous projections. Superomarginal plates usually with short spines, especially near disk. Paxillae area gray to tan in life. Ratio of R (mm): number of superomarginal plates along one side of arm usually > 2…*Astropecten duplicatus*.

Descriptions of the Asteroidea

1. ***Astropecten articulatus*** (Say, 1825)

(Fig. 1)

Index of Synonyms: (1) *Asterias articulata* (2) *Astropecten dubius* (3) *Astropecten articulatus*

References (index of synonyms): Agassiz, A. 1869 (3), 1877 (3); Carrera-Rodriguez & Tommasi 1977 (3); Cerame-Vivas & Gray 1966 (3); Clark, A. H. 1939 (3); 1954 (3); Clark, A. M. & Downey 1992 (3); Clark, H. L. 1898a (3), 1919 (3), 1933 (3), 1941 (3); Cooley 1978 (3); Coues 1871 (3); Coues & Yarrow 1878 (3); Döderlein 1917 (3); Downey 1973 (3); Dragovich & Kelly 1964 (3); Dujardin & Hupé 1862 (3); Engel et al. 1960 (3); Fontaine 1953 (3); Franz et al. 1981 (3); Gray 1840 (2); Gray et al. 1968 (3); Gunter 1950 (3); Gunter & Hall 1965 (3); Hendler et al. 1995 (3); Hildebrand 1955 (3); Hoese 1973 (3); Hutton et al. 1956 (3); Ives 1889 (3), 1890 (3), 1891 (3); John & Clark 1954 (3); Jolley 1972 (3); Kirby-Smith 1978 (3); Ladd 1951 (3); Ladd et al. 1957 (3); Lütken 1864 (3); Lyons et al. 1971 (3); Menzel 1971 (3); Müller & Troschel 1842 (3); Parker 1956 (3); Perrier 1875 (2), 1876 (3), 1878 (3), 1884 (3); Reed 1941 (3); Say 1825 (1); Schwartz & Porter 1977 (3); Shirley 1974 (3); Sladen 1889 (3); Suarez 1974 (3); Tommasi 1970 (3); Tommasi et al. 1988 (3); Tortonese 1936 (3), 1956 (3); Verrill 1867 (3), 1872 (3), 1885 (3), 1895 (3), 1915 (3); Wilson 1900 (3).

Diagnosis: Arms 5, flat, paxillate. Paxillae with granulose or rounded projections. Superomarginal plates large, forming wall around edge of arms. Superomarginal plates usually without 1 - 2 spines. Color deep purple or red-purple.

Description:

r: 15 mm.

R: 85 mm (up to 100 mm).

Arm shape in cross section: Flat, with paxillae area below level of superomarginal plates.

Ocular plate: Small, rectangular and covered with granules.

Plates: Superomarginal plates well formed, rectangular with distinct fasciole areas separating them. Some plates near disk may have 1, short, conical spine. 40 - 50 plates along one edge of an arm. Inferomarginal plates usually with 2 long (3 mm), flat spines on lateral edge that project away from arm. Rest of plate covered with numerous, smaller bristle-like spines. Plates paired with the superomarginal plates.

Surface: Covered with round paxillae. Crown of each paxillae has 8 - 12 small granules

on edge projecting away from center, and 1 - 2 central granules sometimes enlarged into a low conical spine. Paxillae tightly packed together. Madreporite distinct, irregular oval, placed near edge of disk in an interarm axis.

Color: Deep purple, red-purple, or red-brown.

Distribution: Belize, Brazil, Cuba, Dominica, Dry Tortugas, Florida, Georgia, Jamaica, Martinique, Mexico, North Carolina, Puerto Rico, South Carolina, St. Thomas, Texas, Virginia. Bathymetric range - to 200 m.

Discussion: In a preserved state, color quickly disappears making this species superficially harder to distinguish from *A. duplicatus*. A common starfish of sandy bottom areas.

2. *Astropecten duplicatus* Gray, 1840

(Fig. 2)

Index of synonyms: (1) *Astropecten duplicatus* (2) *Astropecten variabilis* (3) *Astropecten buschi* (4) *A. articulatus duplicatus* (5) *Astropecten valenciennii*

References (index of synonyms): Agassiz, A. 1869 (2); Boone 1928 (1); Britton & Morton 1989 (1); Caso 1943 (1), 1953 (1), 1961 (1); Cerame-Vivas & Gray 1966 (1); Clark, A. M. & Downey 1992 (1); Clark, H. L. 1898a (1), 1901a (1), 1919 (1), 1933 (1); Dawson 1966 (1); Defenbaugh 1976 (1); Devaney 1974 (1); Döderlein 1917 (3, 4, 5); Döderlein & Hartmeyer 1910 (1); Dubois 1975 (1); Dujardin & Hupé 1862 (5); Engel et al 1960 (4); Fontaine 1953 (1); Franks et al 1972 (1); Gray et al 1968 (1); Gray 1840 (1), 1866 (1); Gunter 1950 (1); Hendler et al. 1995 (1); Hoese 1973 (1); Hopkins 1979 (1); Hulings 1955 (1); Ives 1891 (1); Jolley 1972 (1); Kirby-Smith 1978 (1); Lima-Verde 1969 (1); Lütken 1859 (2), 1864 (2); McNulty et al 1962 (1); Müller & Troschel 1842 (3, 5); Perrier 1875 (1, 2), 1876 (1), 1878 (1); Reed 1941 (1); de Roa 1967 (4); Sladen 1889 (1); Suarez 1974 (1); Tabb & Manning 1961 (1); Tortonese 1936 (4), 1956 (1); Verrill 1867 (2), 1915 (1); Wass 1961 (1), 1963 (1).

Diagnosis: Arms 5, flat, paxillate. Superomarginal plates large, forming wall around edge of arms. Superomarginal plates usually with 1 - 3 spines. Paxillae with spinous projections. Color tan to gray.

Description:

r: 12 mm.

R: 54 mm (up to 90 mm).

Arm shape in cross section: Flat, with paxillae area below level of superomarginal plates.

Ocular plate: Small, rectangular and covered with granules.

Plates: Superomarginal plates well formed, rectangular with distinct fasciole areas separating them. Each plate may have 0, 1, 2, 3 or rarely more spines. Spines may be only small tubercles or larger, conical forms. Size and placement of spines highly variable even on same specimen. Rest of plate covered with granules. 20 - 30 plates along one edge of an arm. Inferomarginal plates usually with 2 long (3 mm), flat spines on lateral edge that project away from arm. Rest of plate covered with numerous, smaller bristle-like spines. Plates are paired with the superomarginal plates.

Surface: Covered with round paxillae. Crown of each paxillae has 8 - 12 small spinules on edge projecting away from center, and 1 - 2 central granules sometimes enlarged into a low conical spine. Paxillae in center of disk often smaller than those on arms, not tightly packed. Madreporite distinct, irregular oval, placed near edge of disk in an interarm axis.

Color: Tan to gray.

Distribution: Belize, Brazil, Cuba, Dominica, Dry Tortugas, Florida, Georgia, Jamaica, Martinique, Mexico, North Carolina, Puerto Rico, South Carolina, St. Thomas, Texas. Bathymetric range - to 200 m.

Discussion: This species resembles similar sized individuals of *A. articulatus* when preserved. Common in shallow water on sandy bottoms.

3. *Luidia alternata alternata* (Say, 1825)

(Fig. 3)

Index of Synonyms: (1) *Asterias alternata* (2) *Luidia grannulosa* (3) *Luidia variegata* (4) *Luidia numidica* (5) *Luidia alternata* (6) *Luidia bernasconiae* (7) *Luidia quequensis*

References (index of synonyms): Agassiz, A. 1869 (5); Bernasconi 1943 (5, 7); Brito 1962 (5), 1968 (5); Britton & Morton 1989 (5); Caso 1943 (5), 1953 (5), 1961 (5); Carrera-Rodriguez & Tommasi 1977 (7); Cerame-Vivas & Gray 1966 (5); Clark, A. H. 1954 (5); Clark, A. M. 1951 (5); Clark, A. M. & Downey 1992 (5); Clark, H. L. 1898a (5), 1901a (5), 1919 (5), 1933 (5); Cooley 1978 (5); Defenbaugh 1976 (5); Döderlein 1920 (5); Döderlein & Hartmeyer 1910 (5); Downey 1973 (5, 6); Engel et al. 1960 (5), Fontaine 1953 (5); Franz et al. 1981 (5); Godcharles & Jaap 1973 (5); Gray et al. 1968

(5); Hendler et al. 1995 (5); Hildebrand 1954 (5); Hooks et al. 1976 (5); Hopkins 1979 (5); Ives 1890 (5); Jolley 1972 (5); Koehler 1911 (5); Ludwig 1882 (5); Lütken 1859 (5), 1871 (5); Lyons et al. 1971 (5); Mabesoone & Coutinho 1970 (5); Madsen 1950 (5); Menzel 1971 (5); Mukai 1974 (5); Parker 1956 (5), 1959 (5); Pearse & Williams 1951 (5); Perrier 1869 (2), 1876 (2, 5), 1876 (3), 1878 (3, 5), 1884 (5); Reed 1941 (5); Richmond 1962 (5); de Roa 1967 (5); Say 1825 (1); Shirley 1974 (5); Sladen 1889 (5); Suarez 1974 (5); Tommasi 1970 (5), 1974a (5); Tommasi & Aron 1987 (5); Tommasi et al. 1988 (5); Ummels 1963 (5); Verrill 1867 (5), 1915 (5); Walenkamp 1976 (5), 1979 (5).

Diagnosis: Arms 5, flat, with round paxillae and no superomarginal plates. Arms and disk with dark brown bands.

Description:

r: 10 mm.

R: 102 mm (up to 175 mm).

Arm shape in cross section: Flattened on oral side; slightly convex on aboral side.

Ocular plate: Hemispherical, resembling a large tubercle covered with small granules. Granules near aboral apex slightly larger than rest.

Plates: No superomarginal plates. Inferomarginal plates have 4 - 6 large spines decreasing in size from lateral to medial, 4 - 2 mm. Large spines surrounded by smaller bristle-like spines. 84 - 88 plates along one edge of an arm. Adambulacral plates have 3 - 4 large spines, 1 - 3 mm.

Surface: Covered with round paxillae. 18 - 20 paxillae in a band across base of arm. 3 - 4 paxillae on either edge of arm larger than paxillae in middle of arm and disk. Central spine of larger paxillae often large and conical, almost as large as spines on inferomarginal plates. Madreporite covered by paxillae.

Color: Light tan-white with dark brown irregular bands on arms and in middle of disk.

Distribution: Antigua, Argentina, Aruba, Belize, Bonaire, Brazil, Colombia, Cuba, Curçao, Florida, Jamaica, Mexico, Mississippi, Montserrat, North Carolina, Puerto Rico, South Carolina, St. Thomas, Surinam, Texas, Venezuela. Bathymetric range - to 200 m.

Discussion: This species is not as common as *L. clathrata*, but does occur in the sandy bottom areas of the coast. The subspecies *L. a. numidica* occurs on the eastern side of the Atlantic in the Gulf of Guinea.

4. *Luidia clathrata* (Say, 1825)

(Fig. 4)

Index of Synonyms: (1) *Asterias clathrata* (2) *Luidia gemmacea* (3) *Luidia clathrata*

References (index of synonyms): Agassiz, A. 1869 (3), 1877 (3); Bernasconi 1943 (3); de Blainville 1830 (1); Brito 1960a (3), 1962 (3), 1968 (3); Carrera-Rodriguez & Tommasi 1977 (3); Cary 1906 (3); Caso 1943 (3), 1953 (3), 1961 (3), 1979 (3); Cerame-Vivas & Gray 1966 (3); Cherbonnier 1959 (3); Clark, A. H. 1939 (3), 1954 (3); Clark, A. M. 1951 (3); Clark, A. M. & Downey 1992 (3); Clark, H. L. 1898a (3), 1899 (3), 1901 (3), 1901a (3), 1919 (3), 1933 (3), 1942 (3); Cooley 1978 (3); Coues 1871 (3); Coues & Yarrow 1878 (3); Cowles 1930 (3); Defenbaugh 1976 (3); Döderlein 1920 (3); Döderlein & Hartmeyer 1910 (3); Downey 1973 (3); Dragovich & Kelly 1964 (3); Engel et al. 1960 (3); Fontaine 1953 (3); Franks et al. 1972 (3); Franz et al. 1981 (3); Godcharles & Jaap 1973 (3); Gray et al. 1968 (3); Gray 1866 (3); Gunter & Hall 1965 (3); Hendler et al. 1995 (3); Hildebrand 1954 (3), 1955 (3); Hoese 1973 (3); Hooks et al. 1976 (3); Hopkins 1979 (3); Hutton et al. 1956 (3); Ives 1889 (3), 1890 (3), 1891 (3); Jangoux 1978 (3); John & Clark 1954 (3); Johnson et al. 1974 (3); Jolley 1972 (3); Kirby-Smith 1978 (3); Koehler 1911 (3); Livingston 1984 (3); Ludwig 1882 (3); Luederwaldt 1929 (3); Lütken 1959 (3); Lyons et al. 1971 (3); Mabesoone & Coutinho 1970 (3); Menzel 1971 (3); Mukai 1974 (3); Parker 1956 (3), 1959 (3); Parker et al. 1980 (3); Pawson 1986 (3); Perrier 1876 (2, 3), 1878 (3), 1884 (3); Rathbun 1879 (3); Reed 1941 (3); Richmond 1962 (3); de Roa 1967 (3); Say 1825 (1); Schwartz & Porter 1977 (3); Shirley 1974 (3); Sladen 1889 (3); Suarez 1974 (3); Tommasi 1958 (3), 1959 (3), 1970 (3), 1974a (3); Tommasi & Aron 1987 (3); Tommasi et al. 1988 (3); Tortonese 1936 (3); Ummels 1963 (3); Verrill 1867 (3), 1872 (3), 1885 (3), 1895 (3), 1901 (3), 1914 (3), 1914a (3), 1915 (3); Walenkamp 1976 (3), 1979 (3); Wass 1961 (3), 1963 (3), 1965 (3); Wilson 1900 (3); Zieman & Zieman 1989 (3).

Diagnosis: Arms 5, flat, with rectangular paxillae and no superomarginal plates. Color light blue-gray, no banding.

Description:

r: 12 mm.

R: 96 mm (up to 150 mm).

Arm shape in cross section: Flat on oral and aboral sides.

Ocular plate: Oval, 2 mm, covered by fine granules.

Plates: No superomarginal plates. Inferomarginal plates have 1 medium (1.5 mm) and one large (2.5 mm) spine placed on lateral edge. A series of 5 - 8 partially overlapping scale-like spines from large spine to medial edge of plate. 80 - 84 plates along one edge of an

arm. Adambulacral plates have 4 spines; 3 clustered in a triad near edge of inferomarginal plate and 1 set toward ambulacral groove.

Surface: Covered with tightly packed block-like paxillae. Paxillae on disk square to irregularly sided, but most do have distinct sides. Paxillae on arms square medially, rectangular laterally, with progressive size increase from medial to lateral. Lateral paxillae 2 - 3X wider than medial paxillae. Surface of all paxillae granular, none with spines. Madreporite covered by paxillae.

Color: Light blue-gray, usually darker in middle of arm.

Distribution: Aruba, Barbados, Bermuda, Bonaire, Brazil, Colombia, Cuba, Curaçao, Florida, French Guiana, Georgia, Haiti, Jamaica, Louisiana, Mexico, Mississippi, North Carolina, Puerto Rico, South Carolina, St. Thomas, Surinam, Texas, Venezuela, Virginia. Bathymetric range - to 180 m.

Discussion: A common species in sandy bottom coastal areas.

5. *Ophidiaster guildingii* Gray, 1840

(Fig. 5)

Index of Synonyms: (1) *Ophidiaster guildingi* (1a) *Ophidiaster guildingii* (2) *Ophidiaster flaccidus*

References (index of synonyms): Agassiz, A. 1869 (2); Burke 1974 (1a); Carrera-Rodriguez & Tommasi 1977 (1a); Clark, A. H. 1939 (1a), 1954 (1a); Clark, A. M. & Downey 1992 (1); Clark, H. L. 1898a (1a), 1901a (1a), 1919 (1a), 1921a (1a), 1933 (1a); Cubit & Williams 1983 (1a); Devaney 1974 (1a); Döderlein & Hartmeyer 1910 (1a); Downey 1973 (1a); Dubois 1975 (1a); Dujardin & Hupé 1862 (1a); Engel 1939 (1a); Fisher 1928 (1a); Fontaine 1953 (1a); Gray 1840a (1a), 1866 (1a); Heilprin 1888 (1a); Hendler et al. 1995 (1a); Horst 1927 (1a); Lütken 1859 (2), 1871 (1a); Miller 1984 (1); Pawson 1978 (1a); Perrier 1875a (1a), 1878 (1a); Sladen 1889 (1a); Tommasi 1970 (1a); Tommasi & Aron 1988 (1a); Tommasi et al. 1988 (1a); Tortonese 1936 (1a); Ummels 1963 (1a); Verrill 1867 (2), 1915 (1a).

Diagnosis: Arms 5, round to oval, surface covered with granules and 8 straight columns of papullae.

Description:

r: 3.5 mm.

R: 35.5 mm.

Arm shape in cross section: Round to oval.

Ocular plate: Oval to halfmoon-shaped, 2 mm. Proximal side convex, distal side undulated with 4 shallow notches. Surface finely tuberculate.

Plates: Superomarginal plates and inferomarginal plates without spines and not enlarged. Adambulacral plates have 3 spines. 2 smaller medial spines, semi-flattened with blunt tips, projecting into ambulacral groove. 1 larger, more conical, spine placed laterally projecting away from groove. Large spine about 3X medial spines.

Surface: Covered with small granules and distinct papullae. 8 - 12 pores per papulla. Disk area has 18 - 21 papullae. 8 straight columns of papullae, 20 - 24 papullae per column, along arm. Oral most column medial to inferomarginal plates. Plates beneath granules also in regular columns and bands. Madreporite distinct, circular, and set on edge of disk in an interarm axis.

Color: Mottled rust-purple and brown.

Distribution: Antigua, Aruba, Ascension, Barbados, Belize, Bermuda, Bonaire, Brazil, Curaçao, Dry Tortugas, Florida, Jamaica, Panama, Puerto Rico, St. John, St. Thomas, Texas, Tobago. Bathymetric range - to 200 m.

Discussion: Specimens were collected from the Flower Garden reefs and Stetson Bank. Species not very common and restricted to the calcareous banks.

Class Echinoidea

The Echinoidea are echinoderms in which the skeletal ossicles have fused to form plates that in turn fuse to form a test. The test may be radially symmetrical, as in the regular echinoids, or bilaterally symmetrical, as in the irregular echinoids. The test has perforations for the podia and attachment sites for the characteristic spines.

The test of a regular echinoid is divided into five ambulacral and five interambulacral areas, with each area consisting of two columns of plates. The ambulacral areas contain the podia. In a denuded test, the opening for each podium occurs as a pair of pores. The number of pore pairs per plate and their arrangement are diagnostic features.

The interambulacral areas lack pores for podia. They have primary, and in some cases, secondary tubercles for spine attachment. The tubercles may have a small hole in the top (perforate), or they may be smooth (imperforate). The platform around the mamelon of the tubercle may be smooth (noncrenulate), or may have a series of ridges (crenulate).

The aboral pole of the test contains the apical system usually surrounding the periproct. The apical system is a circle of 10 plates, five oculars and five genitals. The ocular plates occur at the aboral end of the ambulacral areas, while the genital plates occur at the aboral end of the interambulacral areas. Each genital plate has a large pore that leads to the gonads. The second genital plate also contains the madreporite. If the ocular plates are in contact with the edge of the periproct, they are said to be insert. If they are in contact only with the genital plates, they are said to be exsert.

The periproct is the area inside the circle of the apical plates and contains the anus. The periproct is made up of a varying number of plates that are connected together by a membrane. Due to the fragile nature of the membrane, the periproct plates are often absent on denuded, preserved specimens.

The oral side of the test contains the peristome. The peristome opening is covered with a membrane that may contain few to many plates. In the center of the membrane is an opening for the Aristotle's lantern. The edge of the test surrounding the peristomial opening may or may not contain gill slits in the form of small notches.

Aristotle's lantern is the chewing apparatus and comes in five basic types: cidaroid, aulodont, stirodont, camarodont and clypeasteroid. The lantern is made up of many different pieces and readily disarticulates, especially when dry.

Whole specimens have spines, and in most cases, some type of pedicellaria. The shape, length and color of the spines are diagnostic features. The pedicellaria are small grasping organs on the surface of the test and are categorized as either globiferous, triphyllous, tridentate or ophicephalous. The globiferous pedicellaria contain external or internal poison glands. The pedicellaria may be especially concentrated in the peristome region.

Irregular echinoids have bilateral symmetry, and the test is usually somewhat to very flattened. The ambulacral areas on the aboral side contain pore pairs concentrated into distinct areas called petals. The five petals are arranged into a bivium and trivium. The bivium contains petal pair I and V (posterior). The trivium contains petal pair II and IV and unpaired petal III (anterior). The area between the bivium petals contains interambulacrum 5. The interambulacral areas between the petals are numbered 1 - 4 counter-clockwise from 5. The ambulacral areas on the oral side are devoid of, or with a few, pores.

In clypeasteroids, the apical system is very compact and located at the aboral juncture of the petals. The anus is located on the oral side, sometimes near the very small peristome.

In spatangoids, the aboral-oral axis has shifted diagonally. The apical system is at the juncture of the petals. The anus is at the posterior end of the test, and the peristome is on the ventral side distinctly set to the anterior end of the test. There is no Aristotle's lantern. The ventral plates directly to the posterior of the peristome have become enlarged to form a base, or plastron, which is bordered by ambulacral areas I and V. The lip of the plastron may overhang the mouth and is termed the labrum. There may also be a phyllode area of large podia around the peristome.

Most of the shallow-water echinoids that occur in the Caribbean also occur in Texas. They occur in all habitat types.

Classification

Phylum Echinodermata

Subphylum Echinozoa

Class Echinoidea

Order Cidaroida

Family Cidaridae

Eucidaris tribuloides tribuloides (Lamarck, 1816)

Order Diadematoida

Family Diadematidae

Diadema antillarum (Philippi, 1845)

Order Arbacioida

Family Arbaciidae

Arbacia punctulata (Lamarck, 1816)

Order Temnopleuroida

Family Toxopneustidae

Lytechinus variegatus (Lamarck, 1816)

Order Echinoida

Family Echinometridae

Echinometra lucunter lucunter (Linnaei, 1758)

Order Clypeasteroida

Family Clypeasteridae

Clypeaster rosaceus (Linnaei, 1758)

Family Mellitidae

Encope michelini L. Agassiz, 1841

Mellita quinquiesperforata (Leske, 1778)

Order Spatangoida

Family Schizasteridae

Moira atropos (Lamarck, 1816)

Family Brissidae

Meoma ventricosa ventricosa (Lamarck, 1816)

Plagiobrissus grandis (Gmelin, 1791)

Key to the Echinoidea

1a. Test hemispherical and radially symmetrical. Pores not concentrated into petals. Spines large, not bristle or hair-like. (regular echinoids)..... 2

1b. Test oval and or flattened with bilateral symmetry. Pores concentrated into petals. Spines small and bristle or hair-like. (irregular echinoids)..... 6

2a. Spine length long, 5 - 6X or more test height. Spines thin, needle sharp and very brittle. Tubercles perforate and crenulate. Periproct without plates….*Diadema antillarum*.

2b. Spine length 2X or less test height. Spines various shapes, but not needle sharp or brittle. Tubercles perforate or imperforate, but all noncrenulate. Periproct with plates 3

3a. Spine length short, 0.5X or less test height. Spines white near base gradually turning white, green, pink or purple near end…*Lytechinus variegatus*.

3b. Spine length near, or just more than test height. Spines red, black-purple or gray. 4

4a. Distinct contrast between primary and secondary spines. Primaries 1 - 1.5X test height, pencil-like, gray and in life often covered with algae or some other encrusting form of life. Secondaries a few millimeters in length, flat and encircling the primaries. Tubercles perforate. Apical system and periproct taking up most of aboral pole, depressed and covered with many small spines…*Eucidaris tribuloides tribuloides*.

4b. No distinct contrast in shape of primary and secondary spines, though secondaries are smaller. Spines in life without encrusting organisms, red to black-purple in color. Tubercles imperforate. Apical system and periproct not taking up most of aboral pole or depressed and if with spines, few in number 5

5a. Spines of three sizes covering all of test, leaving no gaps in which test is clearly visible. Apical system with ring of small spines. Periproct with many, 15 - 18, small plates. Test somewhat flattened aborally. Pore pairs in arcs of 6 – 7…*Echinometra lucunter lucunter*.

5b. Spines more or less one size and symmetrically arranged in columns so that test is clearly visible, especially aborally. Apical system without ring of small spines. Periproct with 4 - 6 large plates. Test not flattened aborally. Pore pairs aligned in a

straight column, not in arcs…*Arbacia punctulata*.

6a. Peristome oral and central. Periproct oral. Petals even with or raised above rest of test surface. Lantern present.....7

6b. Peristome set distinctly anterior on ventral side. Periproct at posterior end away from peristome. Petals sunken to varying degrees below rest of test surface. No lantern 9

7a. Test large, oval and inflated. Petals raised above rest of surface of test, taking up most of dorsal side. Test covered with short bristle-like brown spines. No lunules…*Clypeaster rosaceus*.

7b. Test circular and very flattened. Petals in center of test not raised above rest of surface of test. Test covered with almost microscopic club-shaped spines. Lunules and or notches in edge of test, (sand dollars).....8

8a. Five lunules. Four distal to petals I, II, IV and V, sometimes broken to form notches; and 1 in interambulacrum 5…*Mellita quinquiesperforata*.

8b. One lunule in interambulacrum 5. Five short notches in edge of test, 1 distal to each petal…*Encope michelini*.

9a. Adult small, 40 mm in length, and egg-shaped. Petals are deeply sunken into test forming trenches. In life trenches covered at surface by spines from either edge. Spines on plastron longest with spatulate ends…*Moira atropos*.

9b. Adult large, commonly over 100 mm, widely oval. Petals only slightly depressed in surface of test not forming deep trenches 10

10a. Test broadly oval. Spines short, less than test height, dark brown, bristle-like and nearly all same size. Subanal fasciole incomplete dorsally…*Meoma ventricosa ventricosa*.

10b. Test elongate oval with very flat ventral side. A few, 40, spines on dorsal side longer than test height, the rest short and bristle-like. Spines in marginal areas on ventral side about equal to test height. Subanal fasciole complete and heart-shaped. In life, bright red-orange podia around peristome…*Plagiobrissus grandis*.

Descriptions of the Echinoidea

6. *Arbacia punctulata* (Lamarck, 1816)

(Fig. 6)

Index of Synonyms: (1) *Echinus punctulatus* (2) *Echinocidaris punctulata* (3) *Echinocidaris davisii* (4) *Arbacia punctulata*

References (index of synonyms): Agassiz, A. 1863 (2, 3), 1869 (2), 1872 - 74 (4), 1872a - 74a (4), 1879 (4), 1881 (4), 1883 (4); Agassiz & Clark 1908 (4); Agassiz, L. 1835 (4), 1837 (4); Agassiz & Desor 1846 (2), 1847b (2); Avent et al. 1977 (4); de Blainville 1825 (1), 1830 (1), 1834 (1); Breuer 1962 (4); Britton & Morton 1989 (4); Burke 1974 (4), 1974a (4); Caso 1961 (4), 1979 (4); Caycedo 1979 (4); Cerame-Vivas & Gray 1966 (4); Cherbonnier 1959b (4); Chesher 1972 (4); Clark, A. H. 1954 (4); Clark, H. L. 1904 (4); 1918 (4), 1919 (4), 1925a (4), 1933 (4); Coe 1912 (4); Cooley 1978 (4); Coues 1871 (2); Coues & Yarrow 1878 (4); Cowles 1930 (4); Cubit & Williams 1983 (4); Dawson 1966 (4); Defenbaugh 1976 (4); Des Moulins 1837 (2); Döderlein & Hartmeyer 1910 (4); Dubois 1975 (4); Dujardin & Hupé 1862 (2); Engel 1927 (4), 1939 (4); Fairchild & Sorensen 1985 (4); Gallaway & Lewbel 1982 (4); Godcharles & Jaap 1973 (4); Gray 1835 (4); Greeff 1882a (4); Gunter & Hall 1965 (4); Hay & Sutherland 1988 (4); Hendler et al. 1995 (4); Hildebrand 1955 (4); Hoese 1973 (4); Hopkins 1979 (4); Hopkins et al. 1977 (4); Hulings 1955 (4); Jolley 1972 (4); Kier 1975 (4); Kier & Grant 1965 (4); Kirby-Smith 1978 (4); Koehler 1911 (4); Lamarck 1816 (1); Lovén 1874 (2); Ludwig 1882 (4); Lütken 1863 (2); Mayer 1954 (4); Menzel 1971 (4); Mortensen 1910 (4), 1935 (4); Parker 1959 (4); Pearse 1936 (4); Pearse & Williams 1951 (4); Perrier 1870 (2); Putt et al. 1986 (4); Rathbun 1881 (4), 1881a (4), 1883 (4), 1885a (4), 1886 (4); Reed 1941 (4); Richmond 1968 (4); de Roa 1967 (4); Schwartz & Porter 1977 (4); Serafy 1979 (4); Shirley 1974 (4); Stancyk 1973 (4); Suarez 1974 (4); Sumner et al. 1911 (4); Tommasi 1972 (4); Tortonese 1933 (4); Verrill 1867 (2), 1871 (2), 1872 (4), 1885 (4); Verrill & Rathbun 1879 (4); Wass 1961 (4), 1963 (4), 1965 (4); Whitten et al. 1950 (4); Wilson 1900 (4).

Diagnosis: Test hemispherical. Spine length about equal to test height. Periproct with 4 - 6 large plates. 3 pore pairs per plate, in straight column. Lantern stirodont.

Description:

Whole animal: Urchin hemispherical and circular in outline. Spines in regular columns, all nearly same size, about 1X test height. Distinct clear space aborally in interambulacral areas and around apical system. Usually 4 large periproct plates.

Test size: Diameter = 45 mm. Height = 24 mm.

Test color: Purple-black.

Ambulacrum: Width at ambitus = 7 mm. Pore pairs = 3 per plate, forming a straight column. Plates = 19 - 20 in a column.

Interambulacrum: Width at ambitus = 19 mm. Plates = 14 - 15 in a column.

Primary tubercles: Imperforate, noncrenulate.

Primary spines: Near ambitus 18 - 22 mm. Near aboral and oral poles 14 - 18 mm. 1 mm wide at base gradually tapering to tip, with very fine longitudinal ribbing. Spines around peristome usually have enlarged, blunt and flattened tips. Purple-black.

Secondary spines: Absent.

Fascioles: Absent.

Pedicellaria: Triphyllous, tridentate, and ophicephalous.

Apical system: 10 mm in diameter. Madreporite distinct, but not enlarged. Oculars II and III exsert. Oculars I, IV, and V insert.

Periproct: 5 mm in diameter, with 4 - 6 large, triangular plates.

Peristome: 23 mm in diameter. Margin undulated, gill silts shallow lobed notches. Membrane only has buccal plates that are covered and not distinctly obvious. Buccal podia with tips flared into large suckers. Membrane surface covered with pedicellaria.

Aristotle's lantern: Stirodont.

Lunules: Absent.

Distribution: Alabama, Aruba, Belize, Bonaire, Brazil, Colombia, Connecticut, Cuba, Curaçao, Dry Tortugas, Florida, French Guiana, Georgia, Louisiana, Massachusetts, Mexico, Mississippi, New York, North Carolina, Panama, South Carolina, Texas, Tobago, Trinidad, Venezuela, Virginia. Bathymetric range - to 225 m.

Discussion: The most common sea urchin on the jetties, especially north of Port Aransas. Species also occasionally found in grass areas, on the calcareous banks, and on oil rigs.

Arbacia has the greatest range in its distribution north to south along the Americas of any echinoderm that occurs in Texas.

7. *Clypeaster rosaceus* (Linnaei, 1758)

(Fig. 7)

Index of Synonyms: (1) *Echinus rosaceus* (2) *Echinus reticulatus*_(3) *Echinanthus parvus* (4) *Echinanthus humilis* (5) *Echinorodum rosaceus* (6) *Echinanthus rosaceus* (7) *Clypeaster parvus* (8) *Clypeaster incurvatus* (9) *Clypeaster rosaceus* (10) *Oursin rosace* (11) *Scutum angulare humile*

References (index of synonyms): Agassiz, A. 1863 (9), 1869 (9), 1872 - 74 (6), 1872a - 74a (6), 1879 (6), 1880 (6), 1883 (6); Agassiz, L. 1835 (9), 1837 (9); Agassiz & Desor 1847 (9), 1847 (7), 1847b (7, 9); de Blainville 1817 (9), 1830 (9), 1834 (9); Boone 1933 (9); Bosc 1818 (10); Caycedo 1979 (9); Clark, A. H. 1939 (9), 1954 (9); Clark, H. L. 1898a (6), 1901a (6); 1914 (9), 1918 (9), 1919 (9), 1921 (9), 1933 (9), 1941 (9), 1942 (9); Des Moulins 1837 (8, 9); Döderlein & Hartmeyer 1910 (6); Dujardin & Hupé 1862 (9), 1862 (7); Durham 1955 (9); Engel 1927 (9), 1939 (9); Fontaine 1953b (9); Gallo 1988 (9); Ghiold 1989 (9); Gmelin 1791 (1); Godcharles & Jaap 1973 (9); Gray 1825 (6), 1851 (6); 1855 (6), 1855 (3); Hendler et al. 1995 (9); Hopkins 1988 (9); Hulings 1955 (9); Ives 1891 (6); Kier 1966 (9), 1975 (9); Kier & Grant 1965 (9); Klein 1754 (11); Lamarck 1816 (9); Lambert & Thiery 1909 (9); Leske 1778 (4); Linnaei 1758 (1, 2); Lovén 1874 (9); Lütken 1863 (9); Mayer 1954 (9); Mortensen 1910 (6), 1948 (9); Pomel 1883 (5); Rathbun 1885 (6), 1886 (6); de Roa 1967 (9); Tommasi 1972 (9), 1974a (9); Tommasi & Aron 1987 (9); Tortonese 1933 (9); Verrill 1867 (9); Voss & Voss 1955 (9).

Diagnosis: Test large, oval and inflated. Spines bristle-like. Pore pairs in raised petals. Peristome oral, central and deeply sunken. Lantern clypeasteroid.

Description:

Whole animal: Broadly oval. Test inflated. Petals inflated, taking up most of aboral surface. Short, brown spines give animal a furry appearance. Peristome oral, central and sunken to more than half of test height.

Test size: Length = 145 mm (up to 200 mm). Height = 48 mm. Width = 118 mm.

Test color: Brown.

Ambulacrum: Width at ambitus I and V = 68 mm; II and IV = 62 mm; III = 55 mm. Pore pairs = Concentrated in petals. Petals raised above surface of test by about 5 mm. Petals I

and V = 50 mm long, 32 mm wide with 62 - 65 pores. Petals II and IV = 43 mm long, 35 mm wide with 50 - 55 pores. Petal III = 52 mm long, 29 mm wide with 55 - 60 pores. No pores outside of petals. Plates = Aborally, 4 between end of petals and ambitus. Orally, plates indistinct. Sutures dividing petals longitudinally continue orally as distinct narrow grooves with small secondary tubercles.

Interambulacrum: Width at ambitus 1 and 4 = 20 mm. 2, 3 and 5 = 15 mm. Plates = Aborally, about 8 from apical system to ambitus.

Primary tubercles: Perforate, noncrenulate, set in pits.

Primary spines: Aborally, 2 mm. Orally, 4 mm. Conical with fine longitudinal ribbing. Medium brown.

Secondary spines: Slightly shorter and more narrow than primaries, not in pits.

Fascioles: Absent.

Pedicellaria: Triphyllous, tridentate, ophicephalous.

Apical system: Aboral at juncture of petals. Madreporite central, pentagonal with small tubercles. 5 genital pores, 1 each in middle of sides of pentagon.

Periproct: 5 mm in diameter. Located in the middle of interambulacrum 5 just oral to ambitus. Membrane with small spines.

Peristome: 10 mm across. Pentagonal with concave sides and rounded corners. Peristome sunken 26 mm into central oral area.

Aristotle's lantern: Clypeasteroid.

Lunules: Absent.

Distribution: Aruba, Bahamas, Barbados, Belize, Bermuda, Bonaire, Brazil, Colombia, Cuba, Curaçao, Dominica, Dry Tortugas, Florida, Guadeloupe, Haiti, Jamaica, Mexico, Panama, Puerto Rico, South Carolina, St. Thomas, Texas, Venezuela. Bathymetric range - to 60 m.

Discussion: Reported by Hulings (1955) for the northern coast. I question whether this species is a permanent resident, but it seems unlikely one could misidentify this species of *Clypeaster*. Species prefers soft substrate.

8. *Diadema antillarum* Philippi, 1845

(Fig. 8)

Index of Synonyms: (1) *Cidaris (Diadema) antillarum* (2) *Cidaris diadema* (3) *Cidarites diadema* (3a) *Cidaretes diadema* (4) *Centrostephanus setosus* (5) *Diadema setosum* (5a) *Diadema setosa* (6) *Centrechinus setosus* (7) *Diadema ascensionis* (8) *Diadema turcarum* (9) *Centrechinus antillarum* (10) *Diadema antillarum* (11) *Echinus diadema* (12) *Cidaris variolata rumphii* (13) *Oursin diadema* (14) *Diadema desmarestii*

References (index of synonyms): Agassiz, A. 1863 (10), 1869 (10), 1872 - 74 (5), 1872a - 74a (5), 1879 (5), 1880 (5), 1881 (5), 1883 (5); Agassiz & Clark 1908 (10); Agassiz, L. 1835 (5), 1837 (5); Agassiz & Desor 1846 (8), 1847b (8); Avent et al. 1977 (10); Bacallado et al. 1985 (10); Bertsch 1987 (10); de Blainville 1830 (2), 1834 (2); Boone 1933 (5); Bosc 1818 (13); Brito 1962 (7, 10), 1968 (7), 1971 (7); Britton & Morton 1989 (10); Burke 1974 (10), 1974a (10); Caso 1948 (9), 1953 (10), 1961 (10); Caycedo 1979 (10); Chesher 1966 (10), 1972 (10); Clark, A. H. 1939 (9), 1954 (10); Clark, H. L. 1898 (5), 1898a (5), 1899 (5), 1901 (5), 1901a (5), 1918 (9), 1919 (9), 1921 (9), 1922a (9), 1925a (10), 1933 (9), 1941 (9), 1942 (9); Conant 1900 (5); Cooley 1978 (10); Cubit & Williams 1983 (10); Des Moulins 1837 (8), 1837 (14); Devaney 1974 (10); Döderlein & Hartmeyer 1910 (10); Dubois 1975 (10); Dujardin & Hupé 1862 (8); Engel 1927 (10), 1939 (9); Fontaine 1953b (9); Gallaway & Lewbel 1982 (10); Gallo 1988 (10); Gmelin 1791 (11); Godcharles & Jaap 1973 (10); Gray 1825 (5a); Greeff 1882a (5); Heilprin 1888 (5a); Hendler et al. 1995 (10); Hopkins et al. 1977 (10); Hudson et al. 1970 (10); Ives 1890 (5); Jackson 1914 (6); Kier 1966 (10), 1975 (10); Kier & Grant 1965 (10); Klein 1754 (12); Lamarck 1816 (3); Lambert & Thiery 1909 (4); Leske 1778 (2); Lewis 1961 (9), 1975 (10); Lima-Verde 1969 (7); Lütken 1863 (10); Mabesoone & Coutinho 1970 (10); Mayer 1954 (10); Moore 1958 (10); Mortensen 1909 (7), 1910 (10), 1933 (10), 1936 (10), 1940 (10), 1940 (7); Ogden & Carpenter 1987 (10); Oliveira 1940 (5); Pawson 1978 (10), 1986 (10); Pearson 1936 (9); Perrier 1870 (8); Philippi 1845 (1); Pomel 1883 (5); Putt et al. 1986 (10); Rathbun 1878 (5), 1879 (5), 1885 (5), 1885a (5), 1886 (5); de Roa 1967 (10); Rochebrune 1881 (5); Say 1827 (3a); Serafy 1979 (10); Suarez 1974 (10); Tommasi 1966 (10), 1966a (10), 1972 (10); Tortonese 1933 (10); Verrill 1867 (10); Voss & Voss 1955 (10); Williams et al. 1983 (1).

Diagnosis: Test large, flattened aborally. Spine length at least 5 - 6X test height. Spines thin, sharp, black or banded black and white. Periproct without plates. 3 pore pairs per plate, in straight column. Buccal plates without spines. Lantern aulodont.

Description:

Whole animal: Urchin slightly flattened at aboral pole and circular in outline. Spines in

two sizes. Primaries very long and thin, 6X or more test height even as juveniles. Spines very sharp and brittle. Apical system plates have a few small spines. Urchin, spines included, can be as large as a soccer ball.

Test size: Diameter = 54 mm (up to 110 mm). Height = 24 mm.

Test color: Black.

Ambulacrum: Width at ambitus = 7 mm. Pore pairs = 3 per plate, forming straight column. Plates = 25 - 28 in a column.

Interambulacrum: Width at ambitus = 27 mm. Plates = 13 - 14 in a column.

Primary tubercles: Perforate, crenulate.

Primary spines: On small specimens (14 mm test diameter) spines 58 mm. All larger specimens had the spines broken off near base, but would have spines near 130 - 180 mm long. 1.5 mm wide at base tapering to a very acute point. Milled ring flat with crenulate edge. Spines hollow and constructed of tiered whorls of small lanceolate to spear-shaped plates. Black, or white, or banded black and white. Banded pattern common on juveniles.

Secondary spines: Small versions of primaries, 12 - 15 mm long.

Fascioles: Absent.

Pedicellaria: Triphyllous, tridentate, and ophicephalous.

Apical system: 13 mm in diameter. Madreporite inflated and wider than other genital plates. Ocular II and III exsert. Ocular I, IV, and V insert. Plates have 1 - 2 small tubercles.

Periproct: 9 mm in diameter. Without plates, anus forms a cone.

Peristome: 29 mm in diameter. Margin circular, broken by wide notched gill slits. Membrane only has buccal plates. Buccal podia have enlarged, oval sucker tips. A few scattered pedicellaria near membrane edge. Buccal plates without spines.

Aristotle's lantern: Aulodont.

Lunules: Absent.

Distribution: Aruba, Ascension, Bahamas, Barbados, Belize, Bermuda, Bonaire, Brazil, Canary, Cape Verde, Colombia, Cuba, Curaçao, Dominica, Dominican Republic, Dry Tortugas, Florida, Grenada, Haiti, Jamaica, Louisiana, Mexico, Panama, Puerto Rico, St.

Helena, Texas, Tobago, Venezuela, West Africa. Bathymetric range - to 400 m.

Discussion: The long-spined black urchin occurs on calcareous off-shore banks and oil rigs. Spines are covered with a toxic mucus, and are very sharp, making them almost impossible to handle. Because of the spines' brittleness, whole preserved specimens are very rare. Adults are usually all black, but all white individuals do occur. Juveniles are usually banded black and white, which may persist in some adults.

9. *Echinometra lucunter lucunter* (Linnaei, 1758)
(Fig. 9)

Index of Synonyms: (1) *Echinus lucunter* (2) *Echinus acufera* (3) *Echinus lobatus* (4) *Echinus maugei* (5) *Echinometra acufera* (6) *Echinometra lobatus* (6a) *Echinometra lobata* (7) *Echinometra maugei* (8) *Heliocidaris mexicana* (9) *Echinometra michelini* (10) *Echinometra nigrina* (11) *Echinometra subangularis* (12) *Echinometra lucunter* (13) *Cidaris lucunter* (14) *Cidaris variolata elliptica*

References (index of synonyms): Agassiz, A. 1863 (9), 1869 (9), 1872 - 74 (11), 1872a - 74a (11), 1879 (11), 1880 (11), 1881 (11), 1883 (11); Agassiz, L. 1835 (5, 6a, 12), 1837 (5, 6a, 12); Agassiz & Desor 1846 (5, 6a, 8, 12), 1846 (9), 1847b (6a), 1847b (5, 9, 12); Bell 1881 (11); Bernasconi 1955 (12); de Blainville 1825 (4), 1825 (2), 1825 (1, 3), 1830 (5, 6, 7, 12), 1834 (5, 6a, 12); Boone 1928 (12), 1933 (12); Brito 1960c (12), 1960d (12), 1962 (12), 1968 (12), 1971 (12); Britton & Morton 1989 (12); Caso 1948 (12), 1953 (12), 1961 (12), 1979 (12); Caycedo 1979 (12); Chesher 1966 (12); Clark, A. H. 1939 (12), 1939a (12), 1954 (12); Clark, A. M. 1955 (12); Clark, H. L. 1898 (11), 1898a (11), 1899 (11), 1901 (11), 1901a (11), 1912 (12), 1918 (12), 1919 (12), 1921 (12), 1925a (12), 1933 (12), 1941 (12), 1942 (12); Coleman 1946 (12); Conant 1900 (11); Cubit & Williams 1983 (12); Des Moulins 1837 (2, 7, 12), 1837 (6a); Döderlein & Hartmeyer 1910 (12); Dujardin & Hupé 1862 (5, 12), 1862 (9); Engel 1927 (12), 1939 (12); Fairchild & Sorensen 1985 (12); Fontaine 1953b (12); Gallo 1988 (12); Girard 1850 (10); Gmelin 1791 (12); Gray 1825 (12); Greeff 1882 (11), 1882a (11); Gunter & Hall 1965 (12); Heilprin 1888 (11); Hendler et al. 1995 (12); Ives 1890 (11), 1891 (11); Jackson 1914 (12); Kier 1966 (12); Kier & Grant 1965 (12); Klein 1754 (14); Koehler 1911 (11); Krau 1950 (12); Lamarck 1816 (1); Lambert & Thiery 1909 (6, 11); Leske 1778 (13); Lewis 1960 (12), 1961 (12), 1975 (12); Lima-Verde 1969 (12); Linnaei 1758 (1); Lovén 1874 (12); Ludwig 1882 (11); Luederwaldt 1929 (12); Lütken 1863 (12); Mabesoone & Coutinho 1970 (12); Mayer 1954 (12); Moore 1958 (12); Mortensen 1910 (12), 1933 (12), 1936 (12), 1943a (12), 1951 (12); Oliveira 1940 (11); Pawson 1978 (12), 1986 (12); Pearson 1936 (12); Perrier 1870 (5, 6a, 9, 12); Rathbun 1878

(11), 1879 (11), 1885 (11), 1886 (11); de Roa 1967 (12); Rochebrune 1881 (11); Say 1827 (1); Serafy 1979 (12); Suarez 1974 (12); Thomas 1985 (12); Tommasi 1957 (12), 1959 (12), 1966a (12); Tommasi & Aron 1987 (12); Tortonese 1933 (12), 1933a (12); Verrill 1867 (9), 1868 (9); Voss & Voss 1955 (12); Williams et al. 1983 (12).

Diagnosis: Test flattened aborally. Spine length a little more than test height. Periproct with small plates. Apical system and some periproct plates with very small spines. 6 - 7 pore pairs per plate, arranged in arcs. Lantern camarodont.

Description:

Whole animal: Urchin flattened aborally. Smaller specimens oval in outline; larger ones circular-pentagonal. Spines in three sizes, completely covering test and leaving no distinct clear areas. Longer spines a little more than test height. Apical and periproct plates have small spines. Color varies from light purple-pink to pink-red to dark red to almost black.

Test size: Diameter = 75 mm (up to 85). Height = 35 mm.

Test color: Very dark, almost black, red-purple.

Ambulacrum: Width at ambitus = 17 mm. Pore pairs = Aboral of ambitus pore pairs occur in arcs of 6 - 7, rarely 5 or 8, per plate. Oral of ambitus to peristome arcs straighten into diagonal bands with 4 - 5 pairs per band. Plates = 22 - 24 in a column.

Interambulacrum: Width at ambitus = 28 mm. Plates = 16 - 17 in a column.

Primary tubercles: Imperforate, noncrenulate.

Primary spines: Near ambitus 45 mm. Near peristome 22 mm. 2.5 mm wide at base tapering to tip, with very fine longitudinal ribbing. Tip of spine not acutely pointed. Pink-purple, red, red-purple or almost black.

Secondary spines: Medium sized secondaries 20 - 22 mm long, much more narrow than primaries. Small sized secondaries 8 - 12 mm long and very narrow. Secondaries scattered around primaries.

Fascioles: Absent.

Pedicellaria: Globiferous.

Apical system: 12 mm in diameter. Madreporite 1.5X larger than other genital plates. Plates have 5 - 8 small tubercles. Oculars II, III and IV distinctly exsert. Oculars I and V almost insert.

Periproct: 6 mm in diameter. 12 - 18 pebble-like plates on membrane and 9 - 12 short papillae surrounding anus. Larger pebble-like plates have small tubercles with very small spines.

Peristome: 26 mm in diameter. Margin decagonal with gill slits as very shallow indentations. Membrane with buccal plates. Plates have small spines and pedicellaria. Buccal podia have tips flared into oval suckers. Pedicellaria also occur near edge of membrane.

Aristotle's lantern: Camarodont.

Lunules: Absent.

Distribution: Anguilla, Antigua, Aruba, Ascension, Bahamas, Barbados, Barbuda, Belize, Bermuda, Bonaire, Brazil, Cape Verde, Colombia, Cuba, Curaçao, Dominica, Dominican Republic, Dry Tortugas, Florida, Haiti, Jamaica, Mexico, Panama, Puerto Rico, South Carolina, St. Christopher, St. Croix, St. Helena, St. Thomas, Texas, Tobago, Trinidad, Venezuela, West Africa. Bathymetric range - to 40 m.

Discussion: Previously reported for the Brazos-Santiago Jetty (Fairchild and Sorensen 1985), this is the first record for the Port Aransas Jetty and extends the known range of the species further north along the Texas coast. I have not been able to sample jetties north of Port Aransas to establish whether or not it continues further north along the coast. *E. lucunter* is only found on the jetties and is in Texas probably due to human activity. There are no naturally occurring rocky areas in very shallow water along the coast, and *E. lucunter* is most commonly found subtidally on rock. The population at Port Aransas is well established. I collected specimens in both summer and winter. Small juveniles to full size adults were collected at Brazos-Santiago. The juveniles display the typical oval test common to *E. lucunter* in the rest of the Caribbean; but the adults are all pentagonal to circular, a condition not seen in typical Caribbean specimens. This condition may be a response to the environmental conditions and physical construction of the jetty (e.g. granite rather than calcium carbonate). The subspecies *E. l. polypora* is found on a few mid-Atlantic islands.

10. *Encope michelini* Agassiz, L., 1841

(Fig. 10)

Index of Synonyms: (1) *Encope michelini*

References (index of synonyms): Agassiz, A. 1863 (1), 1869 (1), 1872 - 74 (1), 1872a - 74a (1), 1879 (1), 1883 (1); Agassiz, L. 1841 (1); Agassiz & Desor 1847 (1), 1847b (1); Caso 1948 (1), 1953 (1), 1961 (1); Clark, A. H. 1954 (1); Clark, H. L. 1914 (1), 1919 (1), 1925a (1), 1933 (1), 1941 (1); Cooley 1978 (1); Defenbaugh 1976 (1); Dragovich & Kelly 1964 (1); Dujardin & Hupé 1862 (1); Ghiold 1989 (1); Godcharles & Jaap 1973 (1); Gray 1855 (1); Hendler et al. 1995 (1); Hildebrand 1955 (1); Hulings 1955 (1); Jolley 1972 (1); Kier & Grant 1965 (1); Lambert & Thiery 1909 (1); Lyons et al. 1971 (1); Mayer 1954 (1); McNulty et al. 1962 (1); Menzel 1971 (1); Mortensen 1910 (1); 1948 (1); Perrier 1870 (1); Phelan 1972 (1); Rathbun 1885a (1), 1886 (1); Reed 1941 (1); Serafy 1979 (1); Stancyk 1973 (1); Suarez 1974 (1); Verrill 1867 (1).

Diagnosis: Test flat. Spines minute. Test with 1 lunule and 5 notches in edge.

Description:

Whole animal: Test flat, slightly longer than wide. Spines almost microscopic. 1 complete lunule and 5 notches. Posterior notches form an arrow-head base design. Spines longer on oral surface.

Test size: Length = 70 mm (up to 150 mm). Height = 5 mm. Width = 65 mm.

Test color: Red-brown.

Ambulacrum: Width at ambitus I and V = 18.5 mm. II and IV = 17 mm. III = 16 mm. Pore pairs = Concentrated into petals. Petals I and V = 15 mm long, 5 mm wide with 64 - 68 pores. Petals II and IV = 12 mm long, 5 mm wide with 48 - 52 pores. Petal III = 14 mm long, 6 mm wide with 55 - 62 pores. Petals almost closed at distal end. 2 - 3 plates distal to petals have 1 vestigial pore pair each. No podia orally. Plates = Aborally, 5 - 6 between end of petals and edge of test. Orally, 6 from peristome to edge of test. 5 food grooves. Grooves start out single at peristome and bifurcate at distal edge of first plate continuing to edge of test. Bifurcate grooves form "petal-like" outlines on oral surface.

Interambulacrum: Width at ambitus 1 and 4 = 17 mm. 2 and 3 = 16 mm. 5 = 13 mm. Plates = Aborally, 8 between apical system and edge of test. Orally, 3 from edge of test not coming to peristome. Interambulacral plates extend about 0.66 to peristome from edge of test.

Primary tubercles: Aboral surface imperforate and noncrenulate. Tubercles on oral side in interambulacral areas in pits and appear to be perforate and crenulate.

Primary spines: Aboral surface 1 mm. Edge of disk and in lunules 2 mm. Oral surface in interambulacral areas between food grooves 3 mm, in ambulacral areas between food grooves 2 mm and in food grooves 1 mm. Aboral surface spines club-shaped and finely tuberculate. Spines in lunules and on edge are flat and lanceolate. Oral spines are bristle-like. Red-brown to gray.

Secondary spines: Aboral, thin with very tips sac-like.

Fascioles: Absent.

Pedicellaria: Reported bidentate, not seen.

Apical system: Aboral at juncture of petals. Madreporite large, pentagonal and central. 5 genital pores, 1 each at corners of pentagon in interambulacra 1, 2, 3, 4 and 5.

Periproct: Oral, between peristome and lunule in interambulacrum 5. Oval, 2 mm long, set closer to lunule than peristome. Anus located at proximal end. 4 - 5 large plates at distal end and a few small scale-like plates between large plates and anus.

Peristome: 2 mm in diameter. Margin is circular with no gill slits. Membrane sunken below peristome margin. A butterfly to triangular plate at end of each food groove on margin. Areas between food grooves on margin have flat spines curved towards mouth.

Aristotle's lantern: Clypeasteroid.

Lunules: 1 true lunule and 5 notches. Notch in edge of test in each ambulacrum and a complete lunule in interambulacrum 5. Complete lunule 5.5 mm long, 9 mm from peristome. An imaginary line connecting petals I and V bisects lunule. Notches I and V - 6 mm long. Notches II and IV - 4 mm long. Notch III - 3 mm long.

Distribution: Cuba, Dry Tortugas, Florida, Mexico, North Carolina, Texas. Bathymetric range - to 90 m.

Discussion: This species occasionally occurs in the sandy areas off of South Padre Island and inhabits slightly deeper water than the common five-holed sand dollar.

11. ***Eucidaris tribuloides tribuloides*** (Lamarck, 1816)

(Fig. 11)

Index of Synonyms: (1) *Cidarites tribuloides* (2) *Cidaris tribuloides* (3) *Cidaris metularia* (4) *Eucidaris tribuloides* (5) *Cidaris papillata* (6) *Cidaris minor*

References (index of synonyms): Agassiz, A. 1872 - 74 (2), 1872a - 74a (2), 1879 (2), 1880 (2), 1881 (2), 1883 (2); Agassiz & Clark 1907 (2); Agassiz, L. 1835 (2), 1837 (2); Agassiz & Desor 1846 (2), 1847b (2); Avent et al. 1977 (4); Bernasconi 1955 (4), 1960 (4); Bertsch 1987 (4); Boone 1928 (4), 1933 (4); Brito 1960c (4), 1960d (4), 1962 (4), 1968 (2), 1971 (4); Britton & Morton 1989 (4); Burke 1974 (4), 1974a (4); Caso 1948 (4), 1953 (4), 1961 (4); Caycedo 1979 (4); Cerame-Vivas & Gray 1966 (4); Cherbonnier 1959d (4), Chesher 1966 (4), 1972 (4); Clark, A. H. 1939 (4), 1954 (4); Clark, A. M. 1955 (4); Clark, H. L. 1898 (2), 1898a (2), 1899 (2), 1901 (2), 1901a (2), 1907 (2), 1918 (4), 1919 (4), 1921 (4), 1925a (4), 1933 (4), 1941 (4), 1942 (4); Conant 1900 (2); Cotteau 1892 (2); Cubit & Williams 1983 (4); Des Moulins 1837 (1); Devaney 1974 (4); Döderlein 1887 (4); Döderlein & Hartmeyer 1910 (4); Dujardin & Hupé 1862 (2); Engel 1927 (4), 1939 (4); Fontaine 1953b (4); Gallaway & Lewbel 1982 (4); Gallo 1988 (4); Godcharles & Jaap 1973 (4); Greeff 1882 (2), 1882a (2); Heilprin 1888 (2); Hendler et al. 1995 (4); Hopkins 1979 (4); Hopkins et al. 1977 (4); Hulings 1955 (4); Ives 1891 (2); Jackson 1914 (4); Kier 1966 (4), 1975 (3); Kier & Grant 1965 (4); Koehler 1895 (2), 1898a (2), 1909 (2), 1911 (2), 1914a (2), 1914a (6); Kornicker et al. 1959 (4); Lamarck 1816 (1); Lambert & Thiery 1909 (2); Leske 1778 (5); Lewis 1961 (4); Lima-Verde 1969 (4); Ludwig 1882 (2); Lütken 1863 (3); Mabesoone & Coutinho 1970 (2); Mayer 1954 (4); Moore 1958 (4); Mortensen 1909 (4), 1910 (4), 1928 (4), 1936 (4), 1951 (4); Oliveira 1940 (2); Pearson 1936 (4); Perrier 1870 (2); Phelan 1970 (4); Rathbun 1878 (2), 1879 (2), 1885 (2), 1885a (2), 1886 (2); Reed 1941 (4); Ridley 1890 (2); de Roa 1967 (4); Rochebrune 1881 (2); Serafy 1979 (4); Shirley 1974 (4); Suarez 1974 (4); Tommasi 1958 (4), 1959 (4), 1964 (4), 1966a (4), 1972 (4); Tommasi & Aron 1987 (4), 1988 (4); Tortonese 1933 (4); Voss & Voss 1955 (4); Williams et al. 1983 (4).

Diagnosis: Test flattened aborally. Spine length a little more than test height. Primary spines thick and round with secondaries small and flat. Periproct and apical system large and covered with small spines. 1 pore pair per plate, forming undulated column. Podia form 5 double columns on peristomial membrane. Membrane covered with small spines. Lantern cidaroid.

Description:

Whole animal: Test flattened aborally with apical system, and periproct depressed and covered with small spines. Periproct area takes up most of aboral pole of test. Primary

spines few and thick, a little more than test height. Base surrounded by small, flat secondary spines. Ambulacral areas covered with small spines. Spines line up in very regular columns. Peristome area covered with small, flat, blunt tipped spines.

Test size: Diameter = 54 mm. Height = 33 mm.

Test color: Red-brown to gray.

Ambulacrum: Width at ambitus = 6 mm. Pore pairs = 1 per plate, forming narrow column. Plates = 90 in a column.

Interambulacrum: Width at ambitus = 27 mm. Plates = 9 - 10 in a column.

Primary tubercles: Perforate, noncrenulate.

Primary spines: Near ambitus 38 mm. Near aboral pole 19 mm. Near peristome 12 mm. Elongate cigar-shaped, 4 mm wide at base tapering slightly to blunt, flat tip. Surface covered with small tubercles. Under magnification tubercles pitted. In life there are usually encrusting organisms on the spines. Gray-light purple.

Secondary spines: Scrobicular spines flat, rectangular, 1.5 mm wide and 5 - 6 mm long. Base of spines light tan with brown-orange tips. Scrobicular spines encircle primaries. Ambulacral spines lanceolate, 4 mm long and narrow. Ambulacral spines align in very regular column covering podia. Very small spines, 1 - 2 mm, in both interambulacral and ambulacral areas. Small spines form regular column medial to ambulacral spines, projecting in same direction and overlapping ambulacral spines.

Fascioles: Absent.

Pedicellaria: Globiferous, tridentate.

Apical system: 18 mm in diameter. Madreporite slightly larger than other genital plates. Oculars I, IV and V distinctly insert. Oculars II and III almost insert. Apical plates sunken below edge of and not firmly fused with test. Plates covered with spines, slightly shorter than those covering peristome.

Periproct: 10 mm in diameter and covered with about 30 irregular plates. Plates larger near margin and smaller around anus. Plates covered with small, 2 mm, spines. Periproct on same level with apical system.

Peristome: 24 mm in diameter. Margin undulated, circular. No gill slits. No plates or

buccal podia visible. Podia continue in 5 double columns up to mouth; 1 double column from each ambulacral area of test. Membrane covered with short, 2 - 3 mm, flat spines with slightly enlarged ends. Spines slightly longer than apical system spines.

Aristotle's lantern: Cidaroid.

Lunules: Absent.

Distribution: Antigua, Aruba, Ascension, Azores, Bahamas, Barbados, Brazil, Belize, Bermuda, Bonaire, Cape Verde, Colombia, Cuba, Curaçao, Dominica, Dominican Republic, Dry Tortugas, Florida, French Guiana, Grenada, Haiti, Jamaica, Mexico, North Carolina, Panama, Puerto Rico, South Carolina, St. Helena, St. Thomas, Texas, Tobago, Trinidad, Venezuela, West Africa. Bathymetric range - to 250 m.

Discussion: *Eucidaris* occurs on the off-shore calcareous banks. It can be found in very shallow water in the Caribbean and Florida, but is restricted to deeper off-shore waters in Texas. The subspecies *E. t. africana* occurs in the eastern Atlantic.

12. *Lytechinus variegatus* (Lamarck, 1816)

(Fig. 12)

Index of Synonyms: (1) *Echinus variegatus* (2) *Cidaris variegatus* (3) *Echinus excavatus* (4) *Echinus blainvillii* (5) *Psilechinus variegatus* (6) *Psammechinus variegatus* (7) *Psammechinus excavatus* (8) *Anapesus variegatus* (9) *Tripneustes variegatus* (10) *Toxopneustes variegatus* (11) *Lytechinus carolinus* (12) *Lytechinus atlanticus* (13) *Lytechinus variegatus* (14) *Cidaris assulata variegata*

References (index of synonyms): Agassiz, A. 1863 (11, 12, 13), 1869 (13), 1872 - 74 (10), 1872a - 74a (10), 1879 (10), 1880 (10), 1881 (10), 1883 (10); Agassiz, L. 1835 (1), 1837 (1); Agassiz & Desor 1846 (1), 1846 (3), 1847b (1); Bernasconi 1955 (13); Bertsch 1987 (13); de Blainville 1825 (1, 3), 1830 (1), 1834 (1, 3); Boone 1928 (13), 1933 (13); Breuer 1962 (13); Brito 1960c (13), 1960d (13), 1962 (13), 1968 (13); Britton & Morton 1989 (13); Caso 1961 (13), 1979 (13); Caycedo 1979 (13); Chesher 1966 (13); Clark, A. H. 1939 (13), 1954 (13); Clark, H. L. 1898 (10), 1898a (10), 1899 (10), 1901 (10), 1901a (10), 1912 (13), 1918 (13), 1919 (13), 1921 (13), 1925a (13), 1933, 1941 (13), 1942 (13); Conant 1900 (10); Cooley 1978 (13); Coues 1871 (13); Coues & Yarrow 1878 (10); Cubit & Williams 1983 (13); Dawson 1953 (13); Defenbaugh 1976 (13); Des Moulins 1837 (1, 4); Devaney 1974 (13); Döderlein & Hartmeyer 1910 (6); Dragovich & Kelly 1964 (13); Dubois 1975 (13); Dujardin &

Hupé 1862 (7); Engel 1927 (13), 1939 (13); Fairchild & Sorensen 1985 (13); Fontaine 1953b (13); Gallo 1988 (13); Gmelin 1791 (1); Godcharles 1971 (13); Godcharles & Jaap 1973 (13); Gunter & Hall 1965 (13); Heilprin 1888 (10); Hendler et al. 1995 (13); Hildebrand 1955 (13); Hoese 1973 (13); Hooks et al. 1976 (13); Hopkins 1979 (13); Hopkins et al. 1977 (13); Hutton et al. 1956 (13); Ives 1890 (10), 1891 (10); Jackson 1914 (10); Jolley 1972 (13); Kier 1975 (13); Kier & Grant 1965 (13); Kirby-Smith 1978 (13); Klein 1754 (14); Krau 1950 (13); Lamarck 1816 (1); Lambert & Thiery 1909 (9); Leske 1778 (2); Lima-Verde 1968 (13), 1969 (13); Ludwig 1882 (13); Luederwaldt 1929 (13); Lütken 1863 (5); Lyons et al. 1971 (13); Mabesoone & Coutinho 1970 (13); Mayer 1954 (13); McNulty et al. 1962 (13); Menzel 1971 (13); Mortensen 1910 (10), 1943 (13); Oliveira 1940 (10); Parker 1959 (13); Pawson 1986 (13); Pearse & Williams 1951 (13); Pearson 1936 (13); Perrier 1870 (6); Pomel 1883 (8); Rathbun 1878 (10), 1879 (10), 1885 (10), 1885a (10), 1886 (10); Reed 1941 (13); de Roa 1967 (13); Say 1827 (1); Schwartz & Porter 1977 (10); Serafy 1973 (13), 1979 (13); Stancyk 1973 (13); Suarez 1974 (13); Tommasi 1957 (13), 1959 (13), 1964 (13), 1966a (13), 1967 (13), 1972 (13); Tommasi & Aron 1987 (13), 1988 (13); Tortonese 1933 (13); Verrill 1867 (13), 1868 (13), 1871 (13), 1872 (13); Voss & Voss 1955 (13); Whitten et al. 1950 (13); Wilson 1900 (10); Zieman & Zieman 1989 (13).

Diagnosis: Test hemispherical. Spine length about 0.5X test height. Periproct with about 20 plates. 3 pore pairs per plate, 2 in line and 1 out of line forming 2 close set columns. Lantern camarodont.

Description:

Whole animal: Urchin large and hemispherical. Covered with short white spines about 0.5X test height. A few small spines on apical system. Spines may have pink, purple, or greenish tint near tip. Test either green or pink-red.

Test size: Diameter = 75 mm (up to 85). Height = 40 mm.

Test color: Green (*L. v. variegatus*) or pink-red (*L. v. carolinus*).

Ambulacrum: Width at ambitus = 20 mm. Pore pairs = 3 per plate. Aborally, aboral 2 pairs near adradial suture with third one set distinctly out of line towards perradial suture. Orally near peristome pore pairs form a diagonal band. Plates = 44 - 47 in a column.

Interambulacrum: Width at ambitus = 27 mm. Plates = 28 - 32 in a column.

Primary tubercles: Imperforate, noncrenulate.

Primary spines: Near ambitus 16 mm. Aborally, 10 - 12 mm. Slightly cigar-shaped, 1.5 mm at base with extremely fine longitudinal ribbing on surface. White fading to white or green or pink or purple at tip.

Secondary spines: 3 mm long, narrow and light green.

Fascioles: Absent.

Pedicellaria: Ophicephalous, tridentate, triphyllous and globiferous.

Apical system: 13 mm in diameter. Madreporite inflated. Oculars II, III, and IV exsert. Oculars I and V insert. Plates with a few tubercles and pedicellaria.

Periproct: 8 mm in diameter, covered by about 20 irregular plates. Anus encircled by an additional 10 papillae-like plates. Plates with a few small tubercles and pedicellaria.

Peristome: 21 mm in diameter. Margin circular with distinct gill slit notches. Membrane covered with numerous irregular plates. Buccal plates largest on membrane. Buccal podia have enlarged, circular-oval sucker tips. Pedicellaria scattered over entire surface.

Aristotle's lantern: Camarodont.

Lunules: Absent.

Distribution: Antigua, Aruba, Bahamas, Barbados, Barbuda, Belize, Bermuda, Bonaire, Brazil, Colombia, Cuba, Curaçao, Dry Tortugas, Florida, Georgia, Grenada, Guadeloupe, Haiti, Jamaica, Martinique, Mexico, Mississippi, North Carolina, Puerto Rico, South Carolina, St. Thomas, Texas, Tobago, Trinidad, Venezuela. Bathymetric range - to 100 m.

Discussion: This species is common in grass beds in southern Texas and also occurs on some off-shore calcareous banks. The subspecies *L. v. atlanticus* occurs in Bermuda. The subspecies *L. v. variegatus* (green test) ranges throughout the Caribbean and into southern Texas. The subspecies *L. v. carolinus* (red test) occurs along the south east coast of the U.S. and northern Gulf of Mexico.

13. *Mellita quinquiesperforata* (Leske, 1778)

(Fig. 13)

Index of Synonyms: (1) *Echinodiscus quinquiesperforatus* (2) *Scutella pentapora* (2a) *Scutella pentaphora* (3) *Scutella quinquefora* (4) *Mellita nummularia* (5) *Mellita ampla* (6) *Mellita quinquefora* (7) *Mellita pentapora* (8) *Mellita lata* (9) *Mellita latiambulacra* (10) *Mellita testudinata* (10a) *Mellita testudinaria* (10b) *Mellita testudinea* (11) *Mellita*

quinquiesperforata (12) *Echinus pentaporus* (13) *Oursin pentapore*

References (index of synonyms): Agassiz, A. 1863 (6, 10), 1869 (10), 1872 - 74 (10), 1872a - 74a (10), 1881 (10); Agassiz, L. 1835 (2), 1837 (2), 1841 (6), 1841 (10); Agassiz & Desor 1847 (6, 10), 1847b (6, 10); Behre 1950 (11); Bernasconi 1953 (11), 1955 (11); de Blainville 1827 (3), 1830 (2), 1834 (2); Bosc 1818 (13); Breuer 1962 (11); Brito 1960c (11), 1960e (11), 1962 (11); Britton & Morton 1989 (11); Cary 1906 (10); Caso 1946 (11), 1946 (8), 1953 (11), 1961 (8); Cerame-Vivas & Gray 1966 (11); Clark, A. H. 1939 (11), 1954 (11); Clark, H. L. 1898a (10), 1901a (10), 1904 (7), 1914 (11), 1919 (11), 1925a (11), 1933 (11), 1940a (11), 1940a (8), 1940a (9), 1942 (11); Coe 1912 (7); Cooley 1978 (11); Coues 1871 (6); Coues & Yarrow 1878 (7); Defenbaugh 1976 (11); Des Moulins 1837 (3); Dragovich & Kelly 1964 (11); Dujardin & Hupé 1862 (6, 10); Durham 1955 (11); Engel 1939 (11); Fontaine 1953b (11); Ghiold 1989 (11); Gmelin 1791 (12); Godcharles 1971 (11); Godcharles & Jaap 1973 (11); Gray 1851 (6, 10a), 1855 (10b); Gunter 1950 (11); Gunter & Hall 1965 (11); Harold & Telford 1990 (11); Harper 1970 (11); Hildebrand 1954 (11); Hooks et al. 1976 (11); Hulings 1955 (11); Hutton et al. 1956 (11); Ives 1890 (7); Jolley 1972 (11); Kirby-Smith 1978 (11); Klein 1754 (14); Ladd 1951 (11); Ladd et al. 1957 (11); Lamarck 1816 (3); Lambert & Thiery 1909 (10); Leske 1778 (1); Lima-Verde 1969 (11); Luederwaldt 1929 (11); Lütken 1863 (7); Lyons et al. 1971 (11); Mabesoone & Coutinho 1970 (11); Mayer 1954 (11); McNulty et al. 1962 (11); Menzel 1971 (11); Michelin 1858 (6, 10), 1858 (4), 1858 (5); Mortensen 1910 (10), 1948 (11); Oliveira 1940 (10); Parker 1956 (11), 1959 (11); Pearse 1936 (11); Pearse & Williams 1951 (11); Perrier 1870 (10); Pomel 1883 (10); Rathbun 1879 (10), 1886 (10); Reed 1941 (11); Richmond 1962 (11); de Roa 1967 (11); Say 1827 (2a); Serafy 1979 (11); Shirley 1974 (11); Stancyk 1973 (11); Suarez 1974 (11); Sumner et al. 1911 (11); Tommasi 1957 (11), 1959 (11), 1964 (11), 1966a (11), 1967 (11), 1971b (11), 1974 (11); Tortonese 1933 (11); Verrill 1867 (7, 10b), 1871 (7), 1872 (7); Wass 1961 (1), 1963 (11), 1965 (11); Wilson 1900 (10).

Diagnosis: Test flat. Spines minute. 5 lunules, 4 sometimes broken to form notches.

Description:

Whole animal: Test flat, slightly wider than long. Spines almost microscopic, with club-shaped ends. 5 lunules. 4 marginal lunules sometimes broken to form notches. Spines longer on oral surface.

Test size: Length = 95 mm (up to 110 mm). Height = 6 mm. Width = 100 mm.

Test color: Pale purple-gray-tan.

Ambulacrum: Width at ambitus: I, II, IV and V = 25 mm. III = 30 mm. Pore pairs concentrated into petals. Petals I and V = 23 mm long, 13 mm wide with 70 - 75 pores. Petals II and IV = 18 mm long, 11 mm wide with 55 - 60 pores. Petal III = 20 mm long,

12 mm wide with 55 - 60 por es. Petals almost closed at distal end. No pore pairs outside of petals. No podia orally. Plates = Aborally, 4 - 5 between end of petals and edge of test. Orally, 6 from peristome to edge of test. 5 food grooves. Grooves start out single at peristome and bifurcate at distal edge of first plate continuing to edge of test. Bifurcate grooves form "petal-like" outlines on oral surface.

Interambulacrum: Width at ambitus = 32 mm. Plates = Aborally, 7 between apical system and edge of test. Orally, 3 from edge of test not coming to peristome. Interambulacral plates extend about 0.66 to peristome from edge of test.

Primary tubercles: Aboral surface imperforate and noncrenulate. Tubercles on oral side in interambulacral areas in shallow pits and appear to be perforate and crenulate.

Primary spines: Aboral surface 1 mm. Edge of disk and in lunules 2 mm. Oral surface in interambulacral areas between food grooves 3 mm, in ambulacral areas between food grooves 2 mm and in food grooves 1 mm. Aboral surface spines club-shaped and finely tuberculate. Spines in lunules and on edge flat and lanceolate. Oral spines bristle-like. Gray-tan.

Secondary spines: Thin with very tips sac-like, almost as long as primaries, concentrated on aboral surface between primaries.

Fascioles: Absent.

Pedicellaria: Reported bidentate, not seen.

Apical system: Aboral at juncture of petals. Madreporite large, pentagonal and central. 4 genital pores; 1 in each corner of madreporite pentagon in interambulacra 1, 2, 3 and 4.

Periproct: Oral, between peristome and lunule in interambulacrum 5. Oval, 2 mm long, set closer to lunule than peristome. Anus located at proximal end. 4 - 5 large plates at distal end and a few small scale-like plates between large plates and anus.

Peristome: 2.5 mm in diameter. Margin circular. No gill slits. Membrane sunken below peristome margin. A butterfly to triangular plate at end of each food groove on margin. Areas between food grooves on margin have flat spines curved towards mouth.

Aristotle's lantern: Clypeasteroid.

Lunules: 5 lunules. A lunule at end of each petal in ambulacrum I, II, IV and V; and 1 in

interambulacrum 5. Lunules I and V - 8 mm long and 30 mm from peristome. Lunules II and IV - 9 mm long and 28 mm from peristome. Interambulacral lunule - 13 mm long and 10 mm from peristome. An imaginary line connecting petals I and V bisects interambulacral lunule.

Distribution: Argentina, Aruba, Bonaire, Brazil, Cuba, Curaçao, Florida, Jamaica, Louisiana, Mexico, Mississippi, Puerto Rico, Texas, Trinidad, Venezuela. Bathymetric range - to 40 m.

Discussion: The sand dollar is probably the most abundant echinoderm in Texas. It occurs in sandy surf zones to subtidal areas, usually in water less than 5 m. Many references refer to *Mellita* from the east coast of the U.S., which Harold and Telford (1990) split off and named *M. isometra*, restricting *M. quinquiesperforata* to the western Gulf of Mexico and the Caribbean.

14. ***Meoma ventricosa ventricosa*** (Lamarck, 1816)

(Fig. 14)

Index of Synonyms: (1) *Spatangus ventricosus* (2) *Brissus ventricosus* (3) *Brissus panis* (4) *Meoma ventricosa* (5) *Spatangus brissus* (6) *Brissus maculosus ventricosus* (7) *Echinus spatagus major* (8) *Spatangus maculosus*

References (index of synonyms): Agassiz, A. 1869 (4), 1872 - 74 (4), 1872a -74a (4), 1879 (4), 1881 (4), 1883 (4); Agassiz, L. 1835 (2), 1837 (2); Agassiz & Desor 1847a (2), 1847b (2); Bell 1879 (4); Bertsch 1987 (4); de Blainville 1827a (1), 1830 (1), 1834 (1); Boone 1928 (4), 1933 (4); Brito 1962 (4), 1968 (4); Burke 1974 (4), 1974a (4); Caso 1961 (4); Caycedo 1979 (4); Chesher 1970 (4), 1972 (4); Clark, A. H. 1954 (4); Clark, H. L. 1898a (4), 1917a (4), 1918 (4), 1919 (4), 1925a (4), 1933 (4), 1941 (4); Cubit & Williams 1983 (4); Des Moulins 1837 (8); Döderlein & Hartmeyer 1910 (4); Dujardin & Hupé 1862 (2); Fontaine 1953b (4); Gallo 1988 (4); Ghiold 1989 (4); Gmelin 1791 (7); Godcharles & Jaap 1973 (4); Gray 1825 (2), 1855 (2); Greeff 1882a (4); Grube 1857 (3); Hendler et al. 1995 (4); Hopkins et al. 1977 (4); Kier 1966 (4), 1975 (4); Kier & Grant 1965 (4); Klein 1754 (6); Lamarck 1816 (1); Lambert & Thiery 1909 (4); Leske 1778 (5); Lewis 1961 (4); Lovén 1874 (4); Lütken 1863 (4); Madsen 1957 (4); Martínez de Rodriguez 1969 (4); Mayer 1954 (4); Mortensen 1910 (4), 1951a (4); Pawson 1986 (4); Perrier 1870 (2); Pomel 1883 (4); Rathbun 1885a (4), 1886 (4); de Roa 1967 (4); Serafy 1979 (4); Suarez 1974 (4); Tommasi 1966a (4); Tortonese 1933 (4); Verrill 1867 (4).

Diagnosis: Test egg-shaped, inflated. Spines short and bristle-like. Pore pairs in slightly sunken petals. Petal III vestigial. No lantern.

Description:

Whole animal: Test egg-shaped in outline and inflated. Petals I, II, IV and V form shallow grooves, III vestigial. Spines short, brown giving animal furry appearance.

Test size: Length = 115 mm (up to 200 mm). Height = 55 mm. Width = 106 mm.

Test color: Brown.

Ambulacrum: Pore pairs concentrated into petals. Petals I, II, IV and V form shallow grooves sunken 5 - 6 mm below rest of test surface. Petal III vestigial, only slightly depressed in test surface. Petals I and V =50 mm long, 8 mm wide with 36 - 38 pores. 15 vestigial pores not in pairs from end of petal to peristome. Petals II and IV = 46 mm long, 8 mm wide with 38 - 42 pores. 9 - 10 vestigial pores not in pairs from end of petal to half-way on ventral side. Other half leading to peristome slightly sunken with 8 - 9 pore pairs. Petal III = continues to peristome becoming slightly more sunken near peristome. 21 vestigial pore pairs between apical system and peripetalous fasciole. 10 vestigial pores not in pairs between peripetalous fasciole to near peristome. 5 - 6 pore pairs in sunken area near peristome. Plates = 16 - 17 between end of petals I and V and peristome. Ventral plates have only small tubercles and border plastron. 9 - 10 between end of petals II and IV and peristome.

Interambulacrum: Plates = Areas 1, 2, 3 and 4 with 10 - 12 in column from apical system to plastron. Area 5 with 17 - 18 in column from apical system to labrum, including plastron. Plastron 61 mm long and 37 mm wide.

Primary tubercles: Perforate, crenulate.

Primary spines: Aboral, 4 mm. Petals 5 mm. Oral, 10 mm. Conical, narrow and finely ribbed. Brown.

Secondary spines: Numerous, bristle-like, 2 - 3 mm.

Fascioles: Peripetalous and subanal. Dorsal portion of subanal fasciole not present in larger specimens.

Pedicellaria: Tridentate, triphyllous, and globiferous.

Apical system: Aboral at juncture of petals. Madreporite in interambulacrum 5, bowling pin-shaped. 4 genital pores in interambulacra 1, 2, 3 and 4.

Periproct: Posterior at ambitus and angled ventrally. Oval, 15 mm long with about 60 plates. Plates on ventral margin largest decreasing in size dorsally and centrally to anus. Plates with a few small tubercles.

Peristome: Ventral and anterior, 17 mm wide.

Aristotle's lantern: Absent.

Lunules: Absent.

Distribution: Bahamas, Barbados, Belize, Brazil, Colombia, Cuba, Dry Tortugas, Florida, Grenada, Guadeloupe, Honduras, Jamaica, Mexico, Panama, St. Thomas, Texas, Venezuela. Reported by Greeff (1882) for West Africa? Bathymetric range - to 200 m.

Discussion: *Meoma* is one of the larger echinoids of the area and has been reported near the Flower Garden reefs. It is normally found on, or partially buried in, coarse sandy areas. The subspecies *M. v. grandis* occurs on the Pacific side of Central America.

15. *Moira atropos* (Lamarck, 1816)

(Fig. 15)

Index of Synonyms: (1) *Spatangus atropos* (2) *Schizaster atropos* (3) *Schizaster lachesis* (4) *Echinocardium atropos* (5) *Moira atropos* (6) *Moira lachesis* (7) *Spatangus lacunosus*

References (index of synonyms): Agassiz, A. 1863 (5), 1869 (5), 1872 - 74 (5), 1872a - 74a (5), 1881 (5), 1883 (5); Agassiz, L. 1835 (2), 1837 (2); Agassiz & Desor 1847a (2), 1847b (2); Behre 1950 (5); Bernasconi 1955 (5); de Blainville 1827a (1), 1830 (1), 1834 (1); Boone 1933 (5); Brito 1962 (5), 1968 (5); Britton & Morton 1989 (5); Cary 1906 (5); Cerame-Vivas & Gray 1966 (5); Chesher 1972 (5); Clark, A. H. 1939 (5), 1954 (5); Clark, H. L. 1917a (5), 1919 (5), 1925a (5), 1933 (5), 1942 (5); Cooley 1978 (5); Coues & Yarrow 1878 (5); Des Moulins 1837 (1); Devaney 1974 (5); Döderlein & Hartmeyer 1910 (5); Dujardin & Hupé 1862 (5); Fontaine 1953b (5); Ghiold 1989 (5); Girard 1850 (3); Godcharles 1971 (5); Godcharles & Jaap 1973 (5); Gray 1825 (4), 1855 (2); Gunter & Hall 1965 (5); Hendler et al. 1995 (5); Jolley 1972 (5); Kier 1975 (5); Kirby-Smith 1978 (5); Lamarck 1816 (1); Lambert & Thiery 1909 (5); Leske 1778 (7); Lovén 1874 (5); Luederwaldt 1929 (5); Lütken 1863 (5); Mabesoone & Coutinho 1970 (5); Mayer 1954 (5); McNulty et al. 1962 (5); Menzel 1971 (5); Michelin 1855

(5), 1855 (6); Mortensen 1910 (5), 1951a (5); Parker 1956 (5); Pawson 1986 (5); Pearson 1936 (5); Perrier 1870 (5); Pomel 1883 (5); Rathbun 1886 (5); Reed 1941 (5); de Roa 1967 (5); Say 1827 (1); Serafy 1979 (5); Singletary & Moore 1974 (5); Stancyk 1973 (5); Suarez 1974 (5); Tommasi 1958 (5), 1966a (5), 1971b (5); Tortonese 1933 (5); Verrill 1867 (5), 1872 (5); Wass 1963 (5); Wilson 1900 (5).

Diagnosis: Test oval, small, 40 mm. Spines bristle-like. Periproct posterior. Pore pairs in deeply sunken petals. No lantern.

Description:

Whole animal: Looks like a small furry bird egg. Spines shorter on dorsal side. Sunken grooves containing petals covered by spines, although outline is visible. Lateroanal fasciole appears as a narrow dark stripe. A few pedicellaria around peristome. In side view posterior end is highest part of animal and is vertically flattened. Anterior end rounded.

Test size: Length = 36 mm (up to 57 mm). Height = 22 mm. Width: 32 mm.

Test color: Yellow-gray-brown.

Ambulacrum: Pore pairs concentrated into petals. Petals deeply sunken and almost closed, forming trenches in dorsal surface of test. Petals I and V = 7 mm long. A double column of about 10 pores between end of petals and peristome. Petals II and IV = 16 mm long with a distinct bend 6 mm from proximal end. Groove for proximal 6 mm is almost completely closed off. A double column of about 6 pores between end of petals and peristome. Petal III = 17 mm long. A double column of about 3 pores between end of petal and peristome. Plates = 7 between the end of petals I and V and peristome. Ambulacral areas on ventral side forming a narrow band on either side of plastron. 5 between end of petals II and IV and peristome. 4 between end of petal III and the peristome. Ambulacrum is partially sunken around to ventral side and bisects peristome.

Interambulacrum: Plates = Areas 1 and 4 - 6 in column from apical system to plastron. Areas 2 and 3 - 4 in column from apical system to plastron. Area 5 - 10 in column from apical system to labrum including plastron. Plates between lateroanal fasciole and periproct concave. Plastron 24 mm long, 15 mm wide.

Primary tubercles: Perforate, crenulate.

Primary spines: Near peristome 4 mm. Plastron 5 mm. Dorsally, 1 - 3 mm. Bristle-like

with widened tips. Spines on plastron with distinctly spatulate tips. Gray-brown.

Secondary spines: Very tiny in ambulacral areas bordering plastron.

Fascioles: Lateroanal and peripetalous. Peripetalous fasciole directly borders petal grooves.

Pedicellaria: Only very few globiferous were seen.

Apical system: Aboral at juncture of petals. 2 genital pores in area at proximal end of petals II and IV. Madreporite irregular in shape and central.

Periproct: Posterior, oval, 5 mm long. Raised above surface of test by 8 plates that surround 9 - 10 smaller plates, which in turn surround 11 - 12 smaller, lanceolate plates. Outside 8 plates have a few tubercles.

Peristome: Ventral and anterior, 6 mm wide. 2 tiers of plates, 6 - 7 larger above 7 - 9 smaller. Peristome surrounded by 25 podial pores.

Aristotle's lantern: Absent.

Lunules: Absent.

Distribution: Belize, Bermuda, Brazil, Cuba, Florida, Guadeloupe, Jamaica, Louisiana, Mississippi, North Carolina, South Carolina, St. Thomas, Texas, Venezuela, Virginia. Bathymetric range - to 200 m.

Discussion: This species inhabits soft-bottom areas and is usually found buried several cm into the substrate. The distinct grooves in which the petals lie make this an unmistakable species.

16. ***Plagiobrissus grandis*** (Gmelin, 1788)

(Fig. 16)

Index of Synonyms: (1) *Echinus grandis* (2) *Spatangus pectoralis* (3) *Brissus pectoralis* (4) *Plagionotus desorri* (5) *Plagionotus pectoralis* (6) *Metalia pectoralis* (7) *Plagiobrissus pectoralis* (8) *Plagiobrissus grandis*

References (index of synonyms): Agassiz, A. 1869 (5), 1872 - 74 (6), 1872a - 74a (6), 1881 (6); Agassiz, L. 1835 (3), 1837 (3); Agassiz & Desor 1847a (5), 1847b (3); Bell 1879 (6); de Blainville 1830 (2), 1834 (2); Brito 1962 (8), 1968 (8); Caso 1961 (8); Cerame-Vivas & Gray 1966 (8); Chesher 1972 (8); Clark, H. L. 1917a (8), 1918 (8),

1919 (8), 1925a (8), 1933 (8); Cubit & Williams 1983 (8); de Blainville 1827a (2), 1830 (2); Des Moulins 1837 (2); Dujardin & Hupé 1862 (4, 5); Gallo 1988 (8); Ghiold 1989 (8); Gmelin 1791 (1); Godcharles & Jaap 1973 (8); Gray 1855 (5), 1855 (4); Hildebrand 1955 (8); Hendler et al. 1995 (8); Hulings 1955 (8); Jolley 1972 (8); Kier 1975 (8); Kier & Grant 1965 (8); Lamarck 1816 (2); Lambert & Thiery 1909 (5); Lovén 1874 (5); Luederwaldt 1929 (8); Lütken 1863 (5); Mabesoone & Coutinho 1970 (8); Martínez de Rodriguez 1969 (8); Mayer 1954 (8); McNulty et al. 1962 (8); Menzel 1971 (8); Mortensen 1910 (6), 1951a (8); Pomel 1883 (5); Rathbun 1885a (6), 1886 (6); Serafy 1979 (8); Tommasi 1958 (8), 1959 (8), 1966a (8); Tortonese 1933 (8); Verrill 1867 (5).

Diagnosis: Test elongate oval. Flattened ventral side. A few long spines inside outline of peripetalous fasciole. Ventral spines equal to test height. Plastron spines short. Subanal fasciole heart -shaped with medium spines inside outline.

Description:

Whole animal: Test elongate oval in outline and flattened ventrally, with distinctly different spine sizes. A few long spines on dorsal surface. Marginal areas ventrally also with long spines. Subanal fasciole area with slightly shorter spines. Plastron narrow with short spines. Ventral ambulacral areas look almost naked. No lantern.

Test size: Length = 96 mm (up to 220 mm). Height = 25 mm. Width = 70 mm.

Test color: Tan.

Ambulacrum: Pore pairs concentrated in petals. Petals form slight depressions, 1 - 2 mm, in surface of test. Petal III vestigial. Petals I and V = 31 mm long, 8 mm wide with 28 - 32 pores. Ambulacral areas continue ventrally as narrow bands, with very small tubercles, on either side of plastron. 5 - 6 vestigial unpaired pores from end of petals to ambitus. 6 - 7 vestigial pore pairs from ambitus to near peristome. 3 - 4 pore pairs near peristome. Petals II and IV = 25 mm long, 8 mm with 22 - 25 pores. 6 - 7 vestigial semi-paired pores between end of petals to near peristome. 3 - 4 pore pairs near peristome. Petal III = continues to peristome with no distinct change. 20 - 22 vestigial pore pairs between apical system to near peristome. 3 - 4 pore pairs near peristome. Plates = 16 - 17 between end of petals I and V and peristome. 9 - 10 between end of petals II and IV and peristome.

Interambulacrum: Plates = Areas 1 and 4 - 11 between apical system and plastron. Areas 2 and 3 - 15 between apical system and plastron. Area 5 - 22 from apical system to

labrum, including plastron. Interambulacrum 5 bulges above rest of test surface. Plastron 59 mm long and 11 mm wide.

Primary tubercles: Larger ones perforate and crenulate.

Primary spines: About 40 spines, 35 mm long, in interambulacral areas inside outline of peripetalous fasciole. Rest of dorsal spines 4 - 5 mm. Ventral spines outside of ambulacral areas and plastron 20 mm. Spines within outline of subanal fasciole 8 - 12 mm. Plastron spines 5 - 10 mm. Ventral ambulacral spines 2 - 3 mm. Long spines on dorsal and ventral side flattened, slightly curved. Smaller dorsal spines bristle-like. Plastron spines flattened with partially spatulate tips. Ventral ambulacral spines very thin and hair-like. Tan to brown.

Secondary spines: Thin, 2 - 3 mm.

Fascioles: Peripetalous and subanal. Subanal forms heart-shaped outline.

Pedicellaria: Globiferous, triphyllous and tridentate.

Apical system: Aboral at juncture of petals. Madreporite in interambulacrum 5, bowling pin-shaped. 4 genital pores close together in interambulacra 1, 2, 3 and 4.

Periproct: Posterior at ambitus, not angled. Tear drop-shaped, 8 mm long. Numerous plates, larger near margin with small tubercles.

Peristome: Ventral and anterior, 12 mm wide. Almost no labrum. About 45 plates in 4 tiers gradually decreasing in size from anterior edge to posterior mouth. Mouth with many small overlapping scale-like plates. Larger plates with small tubercles.

Aristotle's lantern: Absent.

Lunules: Absent.

Distribution: Bahamas, Brazil, Colombia, Dominica, Dry Tortugas, Florida, Mexico, North Carolina, Panama, Texas, Venezuela. Bathymetric range - to 200 m.

Discussion: Reported by Hulings (1955) for the northern Texas coast. This species is rarely seen because it almost always stays buried in soft substrate.

Class Holothuroidea

The Holothuroidea are echinoderms in which the aboral/oral axis has become elongate, and the skeleton consists of microscopic, disarticulated ossicles. In many holothuroids, the dorsal and ventral body areas have become differentiated.

The oral, or anterior, end of the body contains the mouth, which is surrounded by a ring of tentacles. The tentacles may be simple, digitate, pinnate, dendritic, or peltate. They vary in number from about 10 to 30 and usually contain rod-shaped ossicles. The tentacles may be mounted on a retractable sheath known as the introvert. The tentacles represent modified podia specialized for feeding. The podia on the rest of the body are used in locomotion. They may be restricted to the five ambulacral areas or radii, or they may occur over the entire body surface. In some cases, the podia are concentrated on the ventral side of the body forming a sole. They may also be entirely absent. The podia usually contain distinctive ossicles, and in some cases, an end plate.

The dermis of the holothuroid usually contains ossicles, which are the main diagnostic feature for the group. The ossicles come in various shapes and are named for common objects they resemble, such as tables, plates, buttons, baskets, wheels, anchors, and rods. The ossicles in different body parts may be different so that one specimen may have several different kinds.

Internally, the holothuroid may or may not have respiratory trees, which are a collection of tubes connected to the cloaca for increased water circulation. They have one or two gonads that are usually in the form of a tufts of tubes. The calcareous ring is near the anterior end of the body cavity. The ring is the insertion point for the water vascular system, muscle attachments, and tentacle attachments. The ring consists of five radial and five interradial pieces of calcium carbonate. The radial pieces usually have an anterior projection that is bifurcate at the end. The posterior edge of the radials may have two long, two short, or no projections. The interradial pieces have a shorter anterior projection that is not bifurcate at the end, and they lack posterior projections.

Holothuroids inhabit jetties, calcareous banks, grass beds, and soft-bottom areas. They are most diverse in soft-bottom regions.

Classification

Phylum Echinodermata

Subphylum Echinozoa

Class Holothuroidea

Order Dendrochirotida

Family Cucumariidae

Thyonella gemmata (Pourtalès, 1851)

Thyonella pervicax (Théel, 1886)

Thyonella sabanillaensis (Deichmann, 1930)

Family Sclerodactylidae

Sclerodactyla briareus (Lesueur, 1824)

Family Phyllophoridae

Allothyone mexicana (Deichmann, 1946)

Thyone pseudofusus (Deichmann, 1930)

Pentamera pulcherrima Ayres, 1852

Order Aspidochirotida

Family Stichopodidae

Isostichopus badionotus (Selenka, 1867)

Family Holothuridae

Holothuria (Holothuria) dakarensis Panning, 1939

Holothuria (Halodeima) grisea Selenka, 1867

Holothuria (Semperothuria) surinamensis Ludwig, 1875

Order Molpadiida

Family Caudinidae

Paracaudina chilensis obesacauda (H.L. Clark, 1907)

Order Apodida

Family Synaptidae

Leptosynapta crassipatina H.L. Clark, 1924

Protankyra benedeni (Ludwig, 1881)

Key to the Holothuroidea

1a. Body with podia 2

1b. Body without podia 12

2a. Tentacles dendritic. Body usually cylindrical. Many forms buried in bottom 3

2b. Tentacles peltate. Body often with distinct ventral sole. Many forms not buried in bottom 9

3a. Body wall ossicles include tables, no buttons; or no ossicles at all 4

3b. Body wall ossicles include buttons, no tables 7

4a. Podia completely restricted to the 5 radii. Tables with distinctly oval disk that has 4 large perforations and tables with larger irregular disk that has 6 - 8 perforations…*Pentamera pulcherrima*.

4b. Podia not restricted to radii (except in some juveniles) 5

5a. Tables with thick, oval disk and 4, sometimes 6, perforations. Spire of table with 2 support pillars, short so that tables almost resemble buttons. A half-ring handle on disks opposite spire. Tentacles have thin rods with a few perforations in ends…*Thyone pseudofusus*.

5b. Tables with 8 or more perforations in circular disk. Spire with 4 support pillars. Tentacles with thick perforated rods. Body wall may be devoid of ossicles 6

6a. Tables with 4 central and 4 peripheral perforations in disk. Body wall may be devoid of ossicles. Podia with tables that have narrow elongate disk and short spire. Calcareous ring with short posterior projections. Podia long, giving body a "hairy" appearance…*Sclerodactyla briareus*.

6b. Tables with 4 - 6 central and 8 - 10 peripheral perforations. Podia have tables with narrow elongate disk and long, thick, reticulate spire. Calcareous ring with long

posterior projections…*Allothyone mexicana*.

7a. Podia scattered over entire surface, no distinct radii. Podia may be more numerous on entire ventral side. Baskets very shallow, 15 - 20 µm deep. Buttons usually in 2 distinct sizes. No perforated plates. Skin very hard due to large numbers of ossicles…*Thyonella pervicax*.

7b. Podia are scattered over entire surface but form double columns in radii that are especially distinct at anterior and posterior ends of body. There is a collection of podia in middle of ventral side. Perforated plates usually present, at least in anterior regions of body. Baskets usually deeper than 35 µm 8

8a. Baskets widely open with 7 - 10 teeth along margin. 30 - 35 µm deep…*Thyonella gemmata*.

8b. Baskets not widely open. Margin undulated with small indistinct teeth and usually small perforations along edge, as well as perforations in body. 38 - 42 µm deep…*Thyonella sabanillaensis*.

9a. Gonads in 2 tufts, 1 on each side of dorsal mesentery. C-shaped ossicles in body wall. Podia in 3 columns on ventral sole. Middle column wider and slightly split medially…*Isostichopus badionotus*.

9b. Gonads in 1 tuft. C-shaped ossicles absent from body wall. Podia may be collected on ventral sole.....10

10a. Ossicles include tables and knobbed buttons with 6 perforations. No rosettes. Body with 2 columns of dark blotches on dorsal side…*Holothuria (Holothuria) dakarensis*.

10b. Ossicles include tables. No buttons 11

11a. Ossicles include large, flat, dentate rods, and tables that have almost no disk. End

of spire forms maltese cross. No plates or rosettes…*Holothuria (Semperothuria) surinamensis*.

11b. Ossicles include perforated plates, rosettes, and tables. Disk of table with a large central and 4 peripheral perforations. Edge of disk with 2 - 3 teeth next to each peripheral perforation…*Holothuria (Halodeima) grisea*.

12a. Ossicles are crossed baskets…*Paracaudina chilensis obesacauda*.

12b. Ossicles are anchors and anchor plates 13

13a. Tentacles with > 4 pairs of digits, plus terminal digit. Anchors < 200 µm. Miliary granules thin rods…*Leptosynapta crassipatina*.

13b. Tentacles with 2 pairs of digits, plus terminal digit. Anchors 600 µm…*Protankyra benedeni*.

Descriptions of the Holothuroidea

17. *Allothyone mexicana* (Deichmann, 1946)

(Fig. 17)

Index of Synonyms: (1) *Thyone mexicana* (2) *Allothyone mexicana*

References (index of synonyms): Britton & Morton 1989 (1); Cooley 1978 (1); Deichmann 1946 (1), 1954 (1); Hulings 1955 (1); Miller & Pawson 1984 (2); Parker 1959 (1); Pawson & Miller 1981 (1); Richmond 1968 (1).

Diagnosis: Tentacles dendritic. Podia found over entire body. Calcareous ring with long posterior projections. Ossicles include body wall tables with 14 - 18 perforations, and podia tables with large, thick, reticulate spires.

Description:

Tentacles: Dendritic. 10, 2 ventral ones smaller.

Podia: Cylindrical, scattered in both interradii and radii; except in small individuals were they are concentrated in radii.

Body length: 11 mm (up to 200 mm).

Calcareous ring: Radials have long posterior projections.

Ossicles: Body wall - Tables: 90 - 140 µm disk, 75 - 85 µm or 10 - 20 µm spire. Fully developed disks have 16 - 18 perforations. Early stage disks have 4 central perforations surrounded by 8 perforations. Spire has 4 pillars closely paired and tapering towards end. Some spires very short. 3 cross bars on longer spires. Podia - Tables: 100 - 160 µm disk, 40 - 120 µm spire. Disk very narrow, slightly curved and made of thick processes. In fully developed tables, spire huge, thick with a reticulate surface of numerous odd shaped processes. Early stage spires more simple with several perforations. End plate: 90 - 110 µm. Margin toothed. Plate with numerous small perforations in center surrounded by larger perforations near margin.

Genital tufts: 2.

Color: Tan-gray.

Distribution: Alabama, Florida, Louisiana, Mississippi, Texas. Bathymetric range - to 10 m.

Discussion: One of the few echinoderms endemic to the northern Gulf of Mexico. This species is usually found in soft-bottom areas or grass beds but is occasionally found on jetties. The specimen I examined was a juvenile and showed different stages in the development of the characteristic spire of the tables from the podia.

18. ***Holothuria (Holothuria) dakarensis*** Panning, 1939

(Fig. 18)

Index of Synonyms: (1) *Holothuria stellati dakarensis* (2) *Holothuria dakarensis* (3) *Holothuria (Holothuria) dakarensis*

References (index of synonyms): Cherbonnier 1950 (2), 1965 (2); Miller & Pawson 1984 (3); Panning 1939 (1); Pawson & Shirley 1977 (3); Rowe 1969 (3); Shirley 1974 (3).

Diagnosis: Tentacles peltate. Podia form ventral sole. Dorsal surface with papillae and dark blotches. Calcareous ring without posterior projections. Ossicles include tables with 1 central and several marginal perforations and knobbed buttons with 6 perforations. Tentacles with spiny rods.

Description:

Tentacles: Peltate. 20 - 25, with ampullae.

Podia: Cylindrical on ventral side and often concentrated into 2 columns. Dorsal side with papillae.

Body length: 65 mm (up to 140 mm).

Calcareous ring: Radials without posterior projections.

Ossicles: Body wall - Tables: 75 - 85 µm disk, 55 - 65 µm spire. Disk has 1 central perforations and 8 - 12 marginal perforations. Smaller disks have fewer marginal perforations. Margin of disk has 12 - 16 teeth. Spire has 4 pillars and 1 cross bar. Knobbed buttons: 70 - 100 µm long, 40 - 50 µm wide. Buttons have 6 perforations arranged in 3 pairs. Knobs small, numerous and scattered over entire surface of button. Podia - Rods: 200 - 300 µm. Rods wider in middle with perforations along edges and small spines on surface. Tables: similar to body wall tables. End plate: 200 - 250 µm. Plate toothed with numerous perforations. Tentacles - Rods: 500 - 550 µm. Rods thick, with numerous small spines surface. Some with a few small perforations.

Genital tufts: 1.

Color: Ground color olive brown, lighter ventrally, with 2 columns of 6 - 8 dark blotches along dorsal surface.

Distribution: Angola, Georgia, Senegal, Texas. Bathymetric range - to 17 m.

Discussion: This species was discovered at Seven and One-Half Fathom Reef by Shirley (1974) and later reported by Pawson and Shirley (1977).

19. *Holothuria (Halodeima) grisea* Selenka, 1867

(Fig. 19)

Index of Synonyms: (1) *Holothuria grisea* (1a) *Holothuria (Halodeima) grisea* (2) *Ludwigothuria grisea*

References (index of synonyms): Ancona-Lopez 1958 (1); Brito 1960 (1), 1962 (1); Caso 1955 (1), 1961 (1); Caycedo 1978 (1a); Clark, H. L. 1901a (1), 1919 (1), 1933 (1); Corvea 1986 (1); Deichmann 1926 (1), 1930 (1), 1954 (1), 1957 (1), 1958 (2), 1963 (2); Domantay 1953 (1), 1958 (1); Engel 1939 (1); Fontaine 1953c (1); Greeff 1882a (1); Hendler et al. 1995 (1a); Krau 1950 (1); Levin & Gomes 1975 (1); Lima-Verde 1969 (2); Ludwig 1882 (1); Luederwaldt 1929 (1); Mabesoone & Coutinho 1970 (1);

Martínez de Rodriguez & Herminson 1975 (2); Miller & Pawson 1984 (1a); Mondin 1973 (2); Panning 1934 (1), 1935 (1); Pawson 1978 (1); Pomory 1989 (1a); Rowe 1969 (1a); Selenka 1867 (1); Sluiter 1910 (1); Suarez 1974 (2); Théel 1886 (1); Tikasingh 1963 (2); Tommasi 1957 (1), 1959 (1), 1966b (2), 1969 (1); Verrill 1867 (1).

Diagnosis: Tentacles peltate. Podia over entire body, but concentrated on ventral side forming a sole. Calcareous ring without posterior projections. Ossicles include tables with 1 central perforation surrounded by 4 perforations. Margin of disk has 10 - 12 teeth. Tentacles and podia golden-yellow.

Description:

Tentacles: Peltate. 20 - 25, with ampullae.

Podia: Cylindrical on ventral side and papillae-like on dorsal side. Dorsal podia on small warts that may be surrounded by a few, more cylindrical podia. Podia on ventral side form a sole.

Body length: 70 mm (up to 250 mm).

Calcareous ring: Radials without posterior projections.

Ossicles: Body wall - Tables: 45 - 55 µm disk, 55 - 65 µm spire. Disk with 1 large central perforation surrounded by 4 smaller perforations. 4 smaller perforations set, 1 each, in four corners of disk. Margin of disk with 9 - 13 teeth; usually 3 teeth next to each outer perforation. Smaller disks may lack 4 marginal perforations. Spire has 4 pillars and 1 cross bar. Cross bar set close to disk. Perforated plates: 40 - 50 µm long, 30 - 40 µm wide. Plate margin toothed. Plate has 4 large central perforations surrounded by 2 - 8 smaller perforations. Smaller plates in form of rosettes. Podia - Rods: 75 - 180 µm. Each end of rods usually has a few teeth and a few perforations. End plate: 200 - 230 µm. Plate has numerous perforations. Tentacles - Rods: 40 - 60 µm. Each end of rods has a few teeth; some also with a few perforations.

Genital tufts: 1.

Color: Tentacles and podia golden yellow. Body dark gray with lighter circular patches on dorsal surface. After extended preservation, tentacles and podia turn white.

Distribution: Antigua, Aruba, Ascension, Bahamas, Barbados, Bonaire, Brazil, Colombia, Cuba, Curaçao, Dry Tortugas, Florida, Haiti, Jamaica, Panama, Puerto Rico,

Mexico, St. Thomas, Surinam, Texas, Tobago, Venezuela, West Africa. Bathymetric range - to 30 m.

Discussion: This species was found in rocky areas along the Texas coast. Specimen was collected at Mansfield and Brazos-Santiago jetties.

20. *Holothuria (Semperothuria) surinamensis* Ludwig, 1875

(Fig. 20)

Index of Synonyms: (1) *Holothuria surinamensis* (1a) *Holothuria (Semperothuria) surinamensis* (2) *Halodeima surinamensis* (3) *Semperothuria surinamensis* (4) *Holothuria languens*

References (index of synonyms): Bertsch 1987 (1); Broeke 1927 (4); Caycedo 1978 (1a), 1979 (1a); Cherbonnier 1951 (2); Clark, A. H. 1939 (1); Clark, H. L. 1898 (1), 1899 (1), 1901 (1), 1901a (1), 1919 (1), 1933 (1), 1942 (1); Deichmann 1930 (1), 1938 (1), 1954 (1), 1958 (3), 1963 (3); Domantay 1953 (1), 1958 (1); Engel 1939 (1); Fontaine 1953c (1); Hendler et al. 1995 (1a); Levin & Gomes 1975 (1); Ludwig 1875 (1); Martínez de Rodriguez 1973 (3); Miller & Pawson 1984 (1a); Mondin 1973 (3); Panning 1934 (1); Pawson 1986 (1a); Reed 1941 (1); Rowe 1969 (1a); Sluiter 1910 (1); Suarez 1974 (3); Théel 1886 (1); Tikasingh 1963 (3); Tommasi 1969 (3).

Diagnosis: Tentacles peltate. Podia scattered over entire body. Calcareous ring without posterior projections. Ossicles include tables with almost no disk as adults and spires ending in maltese cross. Rods with dentate margins.

Description:

Tentacles: Peltate. 20, with ampullae.

Podia: Scattered across entire body surface, more cylindrical ventrally and papillae-like dorsally.

Body length: up to 200 mm.

Calcareous ring: Radials without posterior projections.

Ossicles: Body wall - Tables: 35 - 40 µm disk, 50 - 60 µm spire. Disk reduced to only being end of pillars surrounding a central perforation. 4 pillars and 1 cross bar to spire. Spire ends in maltese cross pattern. Rods: 300 - 500 µm. Rods flat with dentate margins, especially near ends, and may have a few perforations. Podia - Rods: similar to body wall

only slightly curved. End plate: 250 - 300 µm. Plate has numerous perforations. Tentacles - Rods: similar to podia.

Genital tufts: 1.

Color: Light to dark brown.

Distribution: Aruba, Barbados, Bermuda, Bonaire, Brazil, Colombia, Cuba, Curaçao, Florida, Grenada, Jamaica, Puerto Rico, St. Thomas, Texas, Tobago, Trinidad, Venezuela. Bathymetric range - to 42 m.

Discussion: Reported once for Texas coast by Reed (1941) but with no description or collection information. No other records found for Texas. I have seen some tables from *Holothuria grisea* that are not fully formed in which the disk takes the form of a cross. *H. grisea* is relatively common on the southern jetties and might be what Reed collected.

21. *Isostichopus badionotus* (Selenka, 1867)

(Fig. 21)

Index of Synonyms: (1) *Stichopus badionotus* (2) *Stichopus moebii* (2a) *Stichopus mobii* (3) *Stichopus xanthomela* (4) *Stichopus diaboli* (5) *Stichopus maculatus* (6) *Stichopus assimilis* (7) *Stichopus haytiensis* (8) *Stichopus macroparentheses* (9) *Isostichopus macroparentheses* (10) *Isostichopus badionotus*

References (index of synonyms): Ancona-Lopez 1958 (1); Bell 1883 (6); Bertsch 1987 (10); Brito 1960 (1), 1962 (1); Britton & Morton 1989 (10); Broeke 1927 (1); Burke 1974 (10), 1974a (1); Caso 1961 (1); Caycedo 1978 (10), 1979 (10); Cherbonnier 1959c (1), 1975 (1); Clark, A. H. 1939 (1); Clark, H. L. 1898 (2a, 4, 7), 1899 (2a, 4), 1901 (2a), 1901a (2), 1901b (1), 1919 (2), 1922 (1), 1922 (8), 1933 (1), 1933 (8), 1942 (1); Corvea 1986 (1); Defenbaugh 1976 (1); Deichmann 1926 (1, 8), 1930 (1), 1930 (8), 1940 (1), 1954 (1), 1957 (1), 1958 (10), 1963 (10); Domantay 1953 (1), 1958 (1); Dubois 1975 (10); Engel 1939 (1); Fontaine 1953c (1, 8); Greeff 1882a (5); Heilprin 1888 (3); Hendler et al. 1995 (10); Hildebrand 1954 (1); Levin & Gomes 1975 (10); Mabesoone & Coutinho 1970 (1); Martínez de Rodriguez & Herminson 1975 (10); Miller & Pawson 1984 (10); Pawson 1976 (10), 1976 (9), 1978 (10), 1986 (10); Pomory 1989 (10); Putt et al. 1986 (10); Selenka 1867 (1); Shirley 1974 (10); Sluiter 1910 (5), 1910 (1, 7); Suarez 1974 (1); Théel 1886 (2a), 1886 (7), 1886 (1); Thomas 1985 (2); Tikasingh 1963 (10); Tommasi 1957 (1), 1959 (1), 1969 (10); Verrill 1867 (1).

Diagnosis: Tentacles peltate. Large form with squared sides and distinct ventral sole.

Sole has 3 columns of dark tipped podia, with middle column slightly divided. Calcareous ring without posterior projections. Ossicles include C-shaped bodies, and tables with smooth margins and 10 - 12 marginal perforations surrounding 1 large central perforation.

Description:

Tentacles: Peltate. 20, with ampullae.

Podia: Cylindrical, concentrated on ventral side forming a very distinct sole. Ventral podia in 3 columns. Middle column wider and slightly split along its medial length.

Body length: 120 mm (up to 500 mm).

Calcareous ring: Radials without posterior projections.

Ossicles: Body wall - Tables: 45 - 60 µm disk, 30 - 40 µm spire. Disk with 1 large central perforation surrounded by 10 - 12 small marginal perforations. Margin of disk undulated without distinct teeth. Spire has 4 pillars and 1 cross bar. Cross bar set close to disk. C-shaped bodies: 60 - 80 µm. Perforated plates: 100 - 200 µm. Plates very few in number. Podia - Rods: 130 -180 µm. Rods nearly straight, some have a few small teeth and a perforation at one end. End plate: 440 - 500 µm. Plate margin toothed with many perforations. Tentacles - Rods: 200 - 300 µm. Rods thick with a few processes projecting from sides, some perforated.

Genital tufts: 2.

Color: 3 common patterns. Whole body dark rust brown. Body variegated dark rust brown and tan. Body tan with numerous dark brown spots - "chocolate chip cookie" pattern. Podia with dark brown tips. Tentacles light yellow to white.

Distribution: Antigua, Aruba, Ascension, Bahamas, Barbados, Belize, Bermuda, Bonaire, Brazil, Colombia, Cuba, Curaçao, Dry Tortugas, Florida, Grenada, Haiti, Jamaica, Louisiana, Mexico, Puerto Rico, Texas, Tobago, Venezuela, West Africa. Bathymetric range - to 60 m.

Discussion: A very common species in shallow areas of Caribbean and off-shore banks of Texas.

22. *Leptosynapta crassipatina* Clark, 1924

Index of Synonyms: (1) *Leptosynapta crassipatina*

References (index of synonyms): Clark, H. L. 1924 (1); Deichmann 1930 (1), 1954 (1); Hendler et al. 1995 (1); Miller & Pawson 1984 (1).

Diagnosis: Tentacles pinnate with 4 - 5 pairs of digits. Podia absent. Ossicles include anchors, anchor plates, and miliary granules.

Description:

Tentacles: Pinnate, with 4 - 5 pairs of digits. 12.

Podia: Absent.

Body length: up to 40 mm.

Ossicles: Body wall - Anchors: 150 - 170 µm. Anchor plates 145 - 150 µm. Miliary granules: 24 - 26 µm.

Color: White-clear.

Distribution: Florida, Mississippi. Bathymetric range - to 2 m.

Discussion: This species was brought to my attention after the guide was completed (pers. comm. Dr. Donald Harper), and I have not had the opportunity to examine any material for descriptive and illustrative purposes. The descriptions are from the literature. Hendler et al. (1995) suggested that the reports of this species in the Gulf of Mexico may be *L. tenuis*, and that the genus as a whole is in need of revision. There may be several more synaptids from muddy habitats not yet reported from the Texas area.

23. *Paracaudina chilensis obesacauda* (Clark, 1907)

(Fig. 22)

Index of Synonyms: (1) *Caudina obesacauda* (2) *Pseudocaudina obesacauda* (3) *Paracaudina chilensis* (3a) *Paracaudina chilensis var obesacauda* (3b) *Paracaudina chilensis obesacauda* (4) *Paracaudina obesacauda*

References (index of synonyms): Caso 1961 (3); Clark, H. L. 1907a (1), 1933 (1), 1935 (3a); Deichmann 1930 (1), 1940 (4), 1954 (4); Heding 1931 (2), 1932 (4); Hendler et al. 1995 (3b); Miller & Pawson 1984 (3b); Tommasi 1972 (3).

Diagnosis: Tentacles digitate. No podia. Body with short narrow tail. Calcareous ring

with short posterior projections. Ossicles crossed baskets.

Description:

Tentacles: Digitate, with 2 pairs of digits and no terminal digit. 15, with ampullae.

Podia: Absent.

Body length: 12 mm (up to 150 mm).

Calcareous ring: Radials have short posterior projections.

Ossicles: Crossed baskets: 50 - 65 µm. Baskets resemble slightly flattened, hollow spheres with 9 perforations in surface.

Genital tufts: 2.

Color: Gray-white.

Distribution: Florida, Texas. Bathymetric range - to 10 m.

Discussion: This is one of the few shallow-water malpadids. Species occurs on soft-bottom areas. The specimen I examined was very small, but the baskets were in the size range given for adult specimens (Miller and Pawson 1984). I have followed the taxonomy of Miller and Pawson (1984) and Hendler et al. (1995). They list this as subspecies *Paracaudina chilensis obesacauda*. The other subspecies, *P. c. chilensis*, ranges throughout the Pacific. The range of the Gulf of Mexico specimens, however, is apparently very restricted. It was originally (H.L. Clark, 1907) described as a distinct species and has since been moved back and forth between species and subspecies designations. I would prefer to maintain it as a distinct species (*Paracaudina obesacauda*) as Clark originally described it primarily based on the greatly disjunct distributions and habitats of the "subspecies", but will follow the current taxonomic usage for consistency.

24. *Pentamera pulcherrima* Ayres, 1852

(Fig. 23)

Index of Synonyms: (1) *Pentamera pulcherrima* (2) *Cucumaria pulcherrima* (3) *Thyone pulcherrima*

References (index of synonyms): Armstrong 1987 (1); Ayres 1852a (1); Boesch 1973

(2); Clark, H. L. 1904 (2), 1933 (2); Coe 1912 (2); Cooley 1978 (2); Coues & Yarrow 1878 (1); Deichmann 1930 (2), 1941 (1), 1954 (1); Kirby-Smith 1978 (2); Martínez 1982 (1); Miller & Pawson 1984 (1); Panning 1949 (1); Pawson 1977 (1); Pearse & Williams 1951 (2); Selenka 1867 (1); Shirley 1974 (1); Théel 1886 (3); Tommasi 1969 (2), 1974a (2); Tommasi & Aron 1988 (2); Verrill 1872 (1); Wass 1961 (2), 1963 (2), 1965 (2).

Diagnosis: Tentacles dendritic. Podia completely confined to radii. Calcareous ring with long posterior projections. Ossicles include tables with an oval disk and 4 perforations, and tables with a more circular disk and 6 - 8 perforations.

Description:

Tentacles: Dendritic. 10, 2 ventral ones smaller.

Podia: Cylindrical and completely confined to 5 radii. Interradii naked.

Body length: 13 mm (up to 50 mm).

Calcareous ring: Radials have long posterior projections.

Ossicles: Body wall - Tables: 65 - 90 µm disk, 30 - 40 and 15 - 20 µm spire. Disks in 2 types, oval with 4 perforations and circular-irregular with 6 - 8 perforations. Spire with 2 pillars and 1 cross bar, often reduced. Perforated plates: 80 - 100 µm. Plates rectangular with perforations. Podia - Tables: 100 - 130 µm disk, 40 - 55 µm spire. Disk narrow and curved. Spire with 1 - 2 perforations. End plate: 170 - 190 µm. End plate with numerous perforations, larger near dentate margin. Tentacles - Perforated plates-rosettes: 60 - 185 µm. Smaller plates in form of rosettes. Plates with ornate knobbed margins and a few perforations.

Genital tufts: 2.

Color: Dirty white.

Distribution: Brazil, Connecticut, Florida, Massachusetts, North Carolina, South Carolina, Texas, Venezuela, Virginia. Bathymetric range - to 30 m.

Discussion: A small form that prefers soft-bottom areas. This species has rarely been reported from Texas and may have been a misidentification. The tables of this species are usually listed as oval with 4 perforations. Deichmann (1930, 1954) and Miller and Pawson (1984) do not mention the larger irregular disks with more perforations. In the specimens I examined, the larger irregular disks were almost as numerous as the oval

ones.

25. *Protankyra benedeni* (Ludwig, 1881)

Index of Synonyms: (1) *Synapta benedeni* (2) *Protankyra benedeni*

References (index of synonyms): Clark, H. L. 1907a (2); Deichmann 1930 (2); Hendler et al. 1995 (2); Ludwig 1881 (1); Miller & Pawson 1984 (2).

Diagnosis: Tentacles digitate with 2 pairs and a terminal digit. Podia absent. Ossicles include anchors, anchor plates and miliary granules.

Description:

Tentacles: Digitate, with 2 pairs of digits and a small terminal digit. 12.

Podia: Absent.

Body length: up to 35 mm.

Ossicles: Body wall - Anchors: 600 - 630 µm. Anchor plates 450 - 500 µm. Miliary granules: 24 - 26 µm.

Distribution: Deichmann (1930) and Hendler et al. (1995) report that this species has only been recorded from Brazil, but the genus as a whole is rarely found, so distribution records may be lacking in accuracy. Bathymetric range - to 10 m.

Discussion: This species was brought to my attention after the guide was completed (pers. comm. Dr. Donald Harper), and I have not had the opportunity to examine any material for descriptive and illustrative purposes. The descriptions are from the literature. This would be an unusual find as this species has rarely been reported.

26. *Sclerodactyla briareus* (Lesueur, 1824)

(Fig. 24)

Index of Synonyms: (1) *Holothuria briareus* (2) *Anaperus bryareus* (3) *Anaperus carolinus* (4) *Thyonidium glabrum* (5) *Thyone carolina* (6) *Thyone cigaro* (7) *Thyone tenella* (8) *Thyone briareus* (9) *Sclerodactyla briareus*

References (index of synonyms): Agassiz, L. 1835 (8), 1837 (8); Ayres 1851 (9), 1851a (4); Boesch 1973 (8); de Blainville 1830 (1), 1834 (1); Cary 1906 (8); Caso 1961 (8); Cerame-Vivas & Gray 1966 (9); Clark, H. L. 1901b (8), 1904 (8), 1919 (8), 1933 (8);

Coe 1912 (8); Cooley 1978 (8); Coues & Yarrow 1878 (9); Cowles 1930 (8); Deichmann 1930 (8), 1938 (8), 1946 (8), 1954 (8); Godcharles 1971 (9); Godcharles & Jaap 1973 (8); Hendler et al. 1995 (9); Hildebrand 1955 (8); Kirby-Smith 1978 (8); Lesueur 1824 (1); Menzel 1971 (8); Miller & Pawson 1984 (9); Panning 1949 (9); Pawson 1977 (9); Pawson & Miller 1981 (9); Pearse 1936 (8); Pourtalès 1851 (2, 3); Rathbun 1881 (8), 1881a (8), 1883 (8); Schwartz & Porter 1977 (9); Selenka 1867 (8), 1867 (7), 1867 (5, 6); Sumner et al. 1911 (8); Théel 1886 (8); Verrill 1866 (9), 1871 (8), 1872 (8); Verrill & Rathbun 1879 (8); Wass 1961 (8), 1963 (8), 1965 (8); Wilson 1900 (8).

Diagnosis: Tentacles dendritic. Podia scattered on entire body surface, long and hair-like. Calcareous ring broad and thin with short posterior projections. Ossicles may be lacking, but include tables in body wall with 4 central and 4 marginal perforations. Tables in podia with narrow, thick disks and reticulate spires.

Description:

Tentacles: Dendritic. 10, 2 ventral smaller.

Podia: Long and distributed over entire surface of body giving it a "hairy" appearance.

Body length: 79 mm (up to 120 mm).

Calcareous ring: Very broad and thin with short posterior projections on radials.

Ossicles: Body wall - Ossicles may be absent, especially in larger specimens. Tables: 60 - 80 µm disk, 70 - 80 µm spire. Disk has 4 central and 4 marginal perforations. Margin of disk undulated without teeth. Spire has 4 pillars and 1 cross bar. Podia - Tables: 150 - 170 µm disk, 90 - 110 µm spire. Disk thick, narrow, and curved. Spire has 4 pillars that end in a reticulate mass. End plate: 400 - 450 µm. Plate has numerous perforations. Tentacles - Rods: 350 - 400 µm. Rods have many small perforations. Introvert - Tables: 50 - 60 µm disk, 20 - 30 µm spire. Disk has 4 central and 6 - 8 marginal perforations. Spire is usually short with 4 pillars.

Genital tufts: 2.

Color: Brown to brown-olive.

Distribution: Connecticut, Florida, Georgia, Louisiana, Massachusetts, Mexico, New Jersey, New York, North Carolina, South Carolina, Texas, Virginia. Bathymetric range - to 180 m.

Discussion: This is one of the few echinoderms in Texas that has a range restricted to the

Atlantic seaboard of North America. The specimens from Texas I examined had unfortunately been preserved in formalin for a very long time, and not one ossicle could be found anywhere in the body, podia or tentacles. The label stated "Collected in Texas". This species is normally associated with soft-bottom areas near or in grass beds.

27. *Thyone pseudofusus* Deichmann, 1930

(Fig. 25)

Index of Synonyms: (1) *Thyone pseudofusus*

References (index of synonyms): Caso 1961 (1); Clark, H. L. 1933 (1); Deichmann 1930 (1), 1946 (1), 1954 (1); Domantay 1953 (1), 1958 (1); Hendler et al. 1995 (1); Hulings 1955 (1); Miller & Pawson 1984 (1); Panning 1949 (1); Pawson & Miller 1981 (1), 1988 (1); Tommasi 1969 (1), 1974a (1).

Diagnosis: Tentacles dendritic. Podia on entire body surface, but often concentrated in radii. Calcareous ring with long posterior projections. Ossicles include tables with oval, thick disks with 4 perforations. Spires with 2 short pillars. Disk with a half-ring handle on side opposite spire.

Description:

Tentacles: Dendritic. 10, 2 ventral ones smaller.

Podia: Cylindrical, scattered over entire body, but often concentrated into double rows in radii. Double rows in radii often not distinct in some specimens having podia very crowded together.

Body length: 17 mm (up to 20 mm).

Calcareous ring: Radials have long posterior projections. Projections usually broken into many small pieces forming a mosaic pattern.

Ossicles: Body wall - Tables: 115 - 130 µm disk, 25 - 30 µm spire. Disk oval, thick, with 4 perforations and a half-ring handle attached to middle on opposite side from spire. Spire has 2 short, rounded pillars that curve towards middle of disk, ending in a few teeth. Spire resembles half-ring handle only with about 6 - 8 small, blunt, conical teeth at apex. Podia - Tables: 130 - 160 µm disk, 30 - 40 µm spire. Disk somewhat narrow and curved with a few small perforations. Spire has 2 - 3 pillars that end in a few teeth and usually 1 - 2

perforations, especially near base. End plate: 120 - 130 µm. End plate with dentate margin and several irregular perforations. Tentacles - Rods: 120 - 130 µm. Rods thin with enlarged ends, a few perforations in each end. Introvert - Tables: 100 - 115 µm disk, 20 - 30 µm spire. Disk thinner, more irregularly oval than body wall table disks. Rosettes: 30 - 40 µm.

Genital tufts: 2.

Color: Dirty white.

Distribution: Brazil, Dry Tortugas, Florida, Mexico, North Carolina, Texas, Tobago, Tortola. Bathymetric range - to 50 m.

Discussion: A small holothuroid that prefers to burrow in sandy areas.

28. *Thyonella gemmata* (Pourtalès, 1851)

(Fig. 26)

Index of Synonyms: (1) *Colochirus gemmatus* (2) *Thyonidium gemmatum* (3) *Ludwigia gemmata* (4) *Thyone gemmata* (5) *Thyonella gemmata*

References (index of synonyms): Caso 1961 (4); Clark, H. L.1901b (4), 1919 (4); Cooley 1978 (5); Coues & Yarrow 1878 (5); Defenbaugh 1976 (4); Deichmann 1930 (4), 1954 (5); Godcharles 1971 (5); Godcharles & Jaap 1973 (5); Hendler et al. 1995 (5); Kirby-Smith 1978 (4); Menzel 1971 (5); Miller & Pawson 1984 (5); Panning 1949 (3), 1971 (5); Parker et al. 1980 (5); Pawson 1977 (5); Pawson & Miller 1981 (5); Pourtalès 1851 (1), 1869 (2); Selenka 1867 (2); Sluiter 1910 (4); Théel 1886 (4); Verrill 1872 (5).

Diagnosis: Tentacles dendritic. Podia found over entire surface, but concentrated in radii. Calcareous ring without posterior projections. Ossicles include shallow baskets and knobbed buttons.

Description:

Tentacles: Dendritic. 10, 2 ventral ones smaller.

Podia: Cylindrical to mostly short papillae-like and scattered over entire surface, but forming distinct double columns in radii. Double columns most distinct at posterior and anterior ends of body. Usually a cluster of cylindrical podia mid-ventrally.

Body length: 48 mm (up to 150 mm).

Calcareous ring: Radials without posterior projections.

Ossicles: Body wall - Baskets: 45 - 55 µm wide, 30 - 35 µm deep. Baskets widely open with 6 - 8 teeth on top margin. Body of basket with 4 - 6 perforations. Baskets are relatively few in number. Knobbed Buttons: 80 - 110 µm long, 60 - 75 µm wide. Buttons have 4 perforations, extremely numerous. Perforated plates : 200 - 250 µm. Plates ovoid with numerous perforations. Plates occur mainly in anterior portion of body. Podia - Rods: 150 - 320 µm. Rods often tri-armed with a few perforations. Tentacles - Rods: 550 - 560 µm. Rods have numerous small oval perforations. Rods resemble narrow, thick perforated plates. Introvert - Rosettes: 30 - 40 µm. Rods: 50 - 100 µm. Rods have enlarged ends with a few perforations. Smooth buttons: 40 - 45 µm. Smooth buttons have 4 large perforations, very few in number.

Genital tufts: 2.

Color: Gray-brown.

Distribution: Barbados, Brazil, Dry Tortugas, Florida, Georgia, Louisiana, Maryland, Massachusetts, Mexico, North Carolina, South Carolina, Texas, Tobago, Virginia. Bathymetric range - to 20 m.

Discussion: A very common species along the Atlantic seaboard and Gulf of Mexico. This species is found in grass beds and sandy areas. Specimens were collected on the fishing pier at Brazos-Santiago Pass and dredged from a shallow, soft-bottom area along the coast. This species is probably more abundant in Texas waters than past work shows. The record of *Thyonella sabanillaensis* from the area may be this species.

29. *Thyonella pervicax* (Théel, 1886)

(Fig. 27)

Index of Synonyms: (1) *Thyone pervicax* (2) *Thyonella pervicax*

References (index of synonyms): Brito 1962 (1); Clark, H. L. 1933 (1); Deichmann 1930 (1), 1954 (2); Domantay 1958 (1); Hendler et al. 1995 (2); Mabesoone & Coutinho 1970 (1); Miller & Pawson 1984 (2); Mondin 1973 (1); Pawson 1977 (2); Pawson & Miller 1981 (2); Théel 1886 (1); Tommasi 1969 (1).

Diagnosis: Tentacles dendritic. Podia found over entire surface and not in distinct

columns in radii, but may be more concentrated on ventral side. Podia not papillae-like, forming small craters in surface when retracted. Calcareous ring often with short posterior projections. Ossicles include very shallow baskets that may be few in number and large numbers of knobbed buttons. Body very stiff and rough from numerous deposits.

Description:

Tentacles: Dendritic. 10, 2 ventral ones smaller.

Podia: Cylindrical to conical near anterior and posterior ends, appearing like small craters on surface when retracted. Scattered over entire surface, not forming double columns in radii, and more densely concentrated on entire ventral side.

Body length: 65 mm (up to 70 mm).

Calcareous ring: Radials have short posterior projections.

Ossicles: Body wall - Baskets: 40 - 50 µm wide, 15 - 25 µm deep. Baskets widely open with 8 - 12 teeth on top margin, very shallow almost resembling saucers. Body of basket with 4 - 6 perforations. Baskets relatively few in number. Knobbed buttons in two sizes: 35 - 60 µm and 70 - 100 µm long, 25 - 35 µm and 40 - 70 µm wide. Buttons with 4 perforations, extremely numerous. Podia - Rods: 100 - 165 µm. Rods either flattened, club-shaped with a few perforations in the enlarged end; or plate-like, often with 1 - 2 long spines on sides and a few perforations. Tentacles - Rods: 110 - 160 µm. Rods plate-like, sometimes narrowed in middle with several perforations in each end. Introvert - Knobbed buttons: 45 - 55 µm. Buttons have 4 perforations with knobs often smaller and more separated than those on buttons in body wall. Raspberry-shaped nodules: 1000 - 1200 µm. Raspberry nodules few, very distinctive and scattered in introvert and body wall.

Genital tufts: 2.

Color: Light brown.

Distribution: Brazil, Dry Tortugas, Florida, Massachusetts, Panama, Texas. Bathymetric range - to 70 m.

Discussion: A small species common to soft-bottom areas. The specimens were collected by dredging in soft-bottom areas near the coast.

30. *Thyonella sabanillaensis* (Deichmann, 1930)

(Fig. 28)

Index of Synonyms: (1) *Thyone sabanillaensis* (2) *Thyonacta sabanillaensis* (2a) *Thyonacta sabanillensis* (3) *Thyonella sabanillensis* (3a) *Thyonella sabanillaensis*

References (index of synonyms): Breuer 1962 (3a); Cherbonnier 1957 (2), 1959c (2); Deichmann 1930 (1), 1941 (2a), 1954 (3); Miller & Pawson 1984 (3a); Panning 1949 (2a), 1971 (3); Pawson & Miller 1981 (3a); Tommasi 1969 (2), 1974a (2).

Diagnosis: Tentacles dendritic. Podia scattered over surface, but concentrated in radii, very papillae-like in appearance. Calcareous ring with short posterior projections. Ossicles include baskets with perforate body and margin, and smooth to knobbed buttons.

Description:

Tentacles: Dendritic. 10, 2 ventral ones smaller.

Podia: Papillae-like except mid-ventrally. Scattered over s body urface, but concentrated into double columns in radii. Double columns most distinct at anterior and posterior ends of body. Distinct cluster of cylindrical podia mid-ventrally.

Body length: 130 mm (up to 150 mm).

Calcareous ring: Radials have short posterior projections.

Ossicles: Body wall - Baskets: 45 - 55 µm wide, 38 - 42 µm deep. Top margin undulated with a few small teeth and a ring of several perforations above perforations of body. Body of basket with 4 perforations. Mostly knobbed, some smooth, buttons: 80 - 100 µm long, 70 - 90 µm wide. Buttons with 4 perforations. Perforated plates: 200 - 250 µm. Plates ovoid with several perforations. Podia - Rods: 200 - 260 µm. Rods thick, with small perforations. Tentacles - Rods: 450 - 550 µm. Rods mostly thick, with a few perforations. Introvert - Rosettes: 30 - 50 µm.

Genital tufts: 2.

Color: Gray-brown.

Distribution: Brazil, Colombia, Florida, French Guiana, Texas. Bathymetric range - to 30 m.

Discussion: A medium-sized species that prefers soft-bottom areas. I consider this a very doubtful record for Texas. In Deichmann's original description (1930), she stated that this

species had perforated plates, while *T. gemmata* did not. As Miller and Pawson (1984) correctly pointed out, *T. gemmata* does have perforated plates in the anterior regions of the body, and *T. gemmata* does occur in Texas. The main difference is in the baskets. I believe this explains the record for Texas, but since I have not seen the specimens on which the record are based and can not positively say one way or another, I have included it in this report.

Class Ophiuroidea

The Ophiuroidea are stellate echinoderms in which the arms and the disk are distinct from one another. The ambulacral grooves are closed. There is no anus, and the madreporite is on the oral side, usually on one of the oral shields.

The aboral side of an ophiuroid disk may be covered with skin, scales, spines, granules or a combination of the above. In some cases, two enlarged plates called radial shields are found on the disk near the base of each arm. The oral side of the disk contains the mouth frame of five jaws, the proximal part of the arms and five interbrachial areas between the arms.

The interbrachial areas may have the same covering as the aboral side or they may be different. Each interbrachial area contains either two or four genital slits that are found along the edges of the arms.

The distal portion of the jaws contains the oral and adoral shields. The mouth edge of the jaws may be lined with oral papillae. The apex of the jaws in the mouth may have dental papillae and/or dental teeth.

The arms are made of individual segments that are joined together. Each segment is made up of four pieces: an aboral plate, two side plates (one on each side) and an oral plate. The aboral plate may have an accessory plate on each corner or be divided into several pieces. The side plates have the arm spines connected to them. On each proximal corner of the oral plates is an opening for the podia. There may be none to several small scales covering the opening.

The Ophiuroidea are the most diverse class of echinoderms in Texas waters. They

are found in all habitat types and contain several species restricted to off-shore banks.

Classification

Phylum Echinodermata

Subphylum Asterozoa

Class Ophiuroidea

Order Ophiurida

Family Amphiuridae

Amphiodia atra (Stimpson, 1852)

Amphiodia pulchella (Lyman, 1869)

Amphipholis gracillima (Stimpson, 1852)

Ophiophragmus moorei Thomas, 1965

Ophiostigma isocanthum (Say, 1825)

Ophiostigma siva Hendler, 1995

Family Ophiactidae

Hemipholis elongata (Say, 1825)

Ophiactis savignyi (Müller & Troschel, 1842)

Family Ophionereidae

Ophionereis reticulata (Say, 1825)

Family Ophiotrichidae

Ophiothrix (Ophiothrix) angulata (Say, 1825)

Ophiothrix (Acanthophiothrix) suensonii Lütken, 1856

Family Ophiocomidae

Ophiocoma pumila Lütken, 1861

Ophiocoma wendtii Müller & Troschel, 1842

Family Ophiodermatidae

Ophioderma appressum (Say, 1825)

Ophioderma brevispinum (Say, 1825)

Ophioderma rubicundum Lütken, 1856

Ophioderma squamosissimum Lütken, 1856

Family Ophiuridae

Ophiolepis elegans Lütken, 1861

Ophiolepis impressa Lütken, 1861

Key to the Ophiuroidea

1a. Oral interbrachial area with 4 genital slits, 2 along each side of arm 2

1b. Oral interbrachial area with 2 genital slits, 1 along each side of arm 5

2a. Aboral arm plates divided into 7 or more pieces arranged in a symmetric band around arm, 1 piece medial with 3 pieces on each side. Disk granules flat like cobble stones. Size large, to 50 mm disk diameter. Color bright orange-red. Usually found on reefs…*Ophioderma squamosissimum.*

2b. Aboral arm plates undivided or occasionally split in half. Disk granules rounded not flat 3

3a. Radial shields exposed (except in some juveniles). Arm spines 10 - 12, oral most longest, rest all same size, about 0.5X an arm segment. Found inside reef structure. Color red-purple variegated with white…*Ophioderma rubicundum.*

3b. Radial shields covered by granules of disk 4

4a. All arm spines same length, about 0.5X an arm segment. Adoral shields exposed…*Ophioderma brevispinum.*

4b. Oral most arm spine longest and widest. A little more than 0.5X an arm segment. Some to all adoral shields usually, at least in part, covered by granules …*Ophioderma appressum.*

5a. Disk covered with granules. Having both oral and dental papillae. Some arm spines longer than an arm segment 6

5b. Disk covered with scales, spines, or papillae, but not granules. Having either oral or dental papillae, not both..... 7

6a. Second from aboral most arm spine longest, 2X an arm segment, conical-shaped. Aboral side colored tan-brown, oral side white…*Ophiocoma pumila*.

6b. Aboral most arm spine longest, 5 - 6X an arm segment, flattened-conical. Color aboral side almost black, oral side rust orange podia…*Ophiocoma wendtii.*

7a. Having only dental papillae, no oral papillae. Arm spines glassy in appearance distinctly longer than an arm segment. Disk with spines..... 8

7b. Having only oral papillae, no dental papillae. Arm spines not glassy. Disk usually with scales, some also with small spines 9

8a. Spines on disk short, usually not as long as radius of disk and with bifid or trifid ends. Longest arm spine 3 - 4X an arm segment. White stripe bordered by dark stripes, at least distally, along aboral side of arm. Usually found in rock and oyster rubble… *Ophiothrix (Ophiothrix) angulata*.

8b. Spines on disk few in number and very long, almost as long as radius of disk. Radial shields occupy most of disk surface. Longest arm spine 6 - 7X an arm segment. Dark stripe bordered by white stripes along aboral surface of arm. Dark stripe usually continues onto disk surface. Usually found inside sponges or on gorgonians…*Ophiothrix (Acanthophiothrix) suensonii*.

9a. Disk surface with large and small scales. Large scales completely or incompletely surrounded by small scales. Scales may be flat or pebble-like 10

9b. Disk surface with scales all about same size and usually overlapping one another to some degree. No scales pebble-like. Some may also have small spines or papillae on disk 11

10a. Large scales about 4X larger than small scales. Large scales completely encircled by small scales. Scales flat. One column of large scales between radial shields in interarm axis. Scales arranged in very distinct rosette pattern…*Ophiolepis elegans*.

10b. Large scales about 3X larger than small scales, not completely surrounded by small scales. Scales pebble-like, not flat. Three to five columns of large scales between radial shields in interarm axis…*Ophiolepis impressa*.

11a. Disk with "fence" of short spines around entire edge…*Ophiophragmus moorei*.

11b. Disk without spines, or if spines, spines also in central area of disk not confined to edge 12

12a. Disk scales minute. Oral papillae 9 - 10. Disk surface with network of brown to gray lines forming fish-net pattern on disk. Arms white with single segment brown bands every 3 - 4 segments…*Ophionereis reticulata*.

12b. Disk scales medium to large. Oral papillae 6 or less. No fish-net pattern of lines on disk.....13

13a. Arm spines 4 - 5, stubby and tuberculate. Arms often 6 in number. Oral papillae usually 4, 2 oral papillae at each distal angle of jaw. Disk usually with scattered small conical spines. Radial shields with distinct white spot at distal end…*Ophiactis savignyi*.

13b. Arm spines 3, conical. Arms 5 or 6 14

14a. Oral papillae 2 - 3. One oral papillae at each distal angle of jaw and one small, often broken off, papillae at apex of jaw. Oral side of disk naked…*Hemipholis elongata*.

14b. Oral papillae 6, along entire margin of jaw. Oral side of disk not naked 15

15a. Disk covered with short papillae-like spines 16

15b. Disk not covered with spines 17

16a. Aboral arm plates oval to halfmoon-shaped, usually wider than long, most not separated by side arm plates. Ventral arm plates quadrate, slightly wider than long. Adoral shields touching each other at both ends forming continuous ring around jaw. Usually 5 arms…*Ophiostigma isocanthum.*

16b. Aboral and ventral arm plates egg-shaped with wider end distal, usually longer than wide. Aboral arm plates on most of arm separated from one another by side arm plates. Adoral shields touching at jaw but separated where they contact first ventral arm plate. Usually 6, but sometimes 5 arms…*Ophiostigma siva.*

17a. Distal most oral papillae largest, but not distinctly 2 - 3X larger than others. 1 podial scale. Aboral arm plates halfmoon-shaped. Side arm plates large, nearly to completely separating aboral arm plates from one another…*Amphiodia pulchella.*

17b. Distal most oral papillae distinctly larger, 2 - 3X, others. 2 podial scales. Aboral arm plates oval. Side arm plates not large, not separating aboral arm plates from one another.....18

18a. Marginal border of raised scales in single line forming bell curve near edge of disk in interarm region. Border is visible to unaided eye. Proximal most oral papillae close together. Oral shields in the shape of diamond-cross, as wide as long…*Amphiodia atra.*

18b. No marginal border of raised scales near edge of disk. Proximal most oral papillae separated by large gap that is filled by oral most dental tooth. Oral shields elongate arrows with blunt point proximal, distal edge extremely convex…*Amphipholis gracillima.*

Descriptions of the Ophiuroidea

31. *Amphiodia atra* (Stimpson, 1852)

(Fig. 29)

Index of Synonyms: (1) *Ophiolepis atra* (2) *Ophiolepis limbata* (3) *Amphiura atra* (4) *Amphiura limbata* (5) *Amphiodia atra* (6) *Amphiodia limbata* (7) *Amphiodia gyraspis* (8) *Amphipholis atra* (9) *Amphipholis limbata* (10) *Diamphiodia atra* (11) *Diamphiodia limbata* (12) *Diamphiodia gyraspis* (13) *Micropholis atra* (14) *Microphiopholis atra*

References (index of synonyms): Armstrong 1987 (13); Boesch 1973 (5); Clark, A. H. 1920 (5, 6, 7), 1920 (9), 1939 (7); Clark, H. L. 1901a (9), 1915 (5), 1915 (6, 7), 1919 (7), 1933 (6, 7); Cooley 1978 (5); Cowles 1930 (5); Dawson 1966 (5); Dujardin & Hupé 1862 (2); Fell 1962 (10, 11, 12); Grube 1857 (2), 1857a (2); Harper 1970 (13); Hendler et al. 1995 (5); Holland et al. 1973 (13); Ljungman 1866 (8), 1866 (9); Lyman 1865 (3), 1875 (3), 1875 (4), 1882 (4), 1882 (3); Manso & Absalao 1988 (13); Parker 1956 (6), 1959 (6); Parker et al. 1980 (13); Parslow & Clark 1963 (5, 6, 7); Rathbun 1879 (9); Richmond 1962 (6, 7); de Roa 1867 (5); Stimpson 1852 (1); Thomas 1964 (5), 1966 (13); Tommasi 1967 (13), 1970a (13), 1971b (13), 1974 (13); Tommasi & Aron 1988 (13); Tommasi et al. 1988 (13); Turner 1985 (14); Verrill 1867 (4), 1899a (5), 1899a (9); Wass 1961 (5), 1963 (5), 1965 (5).

Diagnosis: Disk with overlapping scales. Single line of slightly raised scales forms border around disk. Radial shields exposed. Aboral arm plates undivided. Arm spines 3, slightly longer than an arm segment. Oral papillae 6. Podial scales 2.

Description:

r: 5 mm.

R: 67 mm.

Disk surface: Covered with small scales, partially overlapping. Central scale not very distinct in large specimens. Scales in central disk area roughly same size. Single line of raised scales forms distinct marginal border just proximal to edge of disk.

Radial shields: Exposed, 1 x 1.5 mm, triangular to egg-shaped - wider end distal. Distal third of shields in contact with one another. Proximal two-thirds separated by a few scales.

Aboral arm plates: Undivided, oval, 2.5X wide as long, in contact medially not laterally.

Supplementary arm plates: Absent.

Arm spines per side arm plate: 3, conical, 1.2X arm segment, aboral most spine may be slightly shorter than rest.

Oral interbrachial surface: Continuation of disk surface distal to marginal border scales. Scales near margin small, gradually increasing in size near oral shield area of interbrachium.

Genital slits: 2 per interbrachium.

Number of oral papillae per jaw: 6, 3 per side.

Dental papillae: Absent.

Podial scales: 2, proximal scale - oval, smaller; distal scale – halfmoon-shaped, larger.

Color aboral surface: Disk and arms gray-tan.

Color oral surface: Off white.

Distribution: Brazil, Florida, Louisiana, Mississippi, Puerto Rico, South Carolina, Texas, Tobago, Trinidad, Venezuela, Virginia. Bathymetric range - to 30 m.

Discussion: A very common inhabitant of sandy bottom coastal areas. This is one of the three most common brittlestars in Texas coastal waters.

32. *Amphiodia pulchella* (Lyman, 1869)

(Fig. 30)

Index of Synonyms: (1) *Amphiura pulchella* (2) *Amphiura repens* (3) *Amphiodia repens* (4) *Gymnodia repens* (5) *Amphiodia pulchella* (6) *Amphipholis pulchella*

References (index of synonyms): Clark, A. H. 1920 (3, 5), 1954 (3, 5); Clark, A. M. 1970 (3, 5); Clark, H. L. 1901a (5), 1915 (3), 1915 (5), 1919 (3, 5), 1933 (3, 5), 1942 (3); Cubit & Williams 1983 (3); Dubois 1975 (5); Fell 1960 (5), 1962 (4), 1962 (5); Fontaine 1953a (3); Hendler et al. 1995 (5); Hendler & Peck 1988 (5); Hudson et al. 1970 (5); Hulings 1955 (3, 5); Koehler 1914 (5); Ljungman 1871 (6); Lyman 1869 (1), 1875 (2), 1875 (1), 1882 (1, 2); Manso & Absalao 1988 (5); McNulty et al. 1962 (5); Shirley 1974 (5); Thomas 1962a (5); Tommasi 1970a (5); Verrill 1899 (5), 1899a (3, 5).

Diagnosis: Disk with overlapping scales. Radial shields exposed. Aboral arm plates undivided with convex proximal edge. Arm spines 3, equal to an arm segment. Oral papillae 6. Podial scales 1.

Description:

r: 1.5 mm.

R: 28.5 mm (up to 50 mm).

Disk surface: Covered with small to medium overlapping scales in no distinct pattern. Scales in interarm axis more overlapped than scales around radial shields.

Radial shields: Exposed, 4 - 5X long as wide, rectangular, and joined for entire length. 1 scale divides very proximal tip of shields giving end of joined shields a bilobed appearance. Distal end of each shield has an accessory lobe-like plate.

Aboral arm plates: Undivided. First several plates broadly oval. Rest of plates halfmoon-shaped - proximal side convex forming almost a half-circle, distal side straight to slightly convex. Side arm plates large, and on some to many segments, just barely separating aboral arm plates from one another. Separation more distinct distally on arm.

Supplementary arm plates: Absent.

Arm spines per side arm plate: 3, lanceolate to flattened conical with bluntly rounded tips and very fine serrate teeth bordering edges, 1X arm segment.

Oral interbrachial surface: Same as disk.

Genital slits: 2 per interbrachium.

Number of oral papillae per jaw: 6, 3 per side.

Dental papillae: Absent.

Podial scales: 1, oval to fan-shaped.

Color aboral surface: Disk gray. Arms often irregularly banded with darker gray.

Color oral surface: Off white.

Distribution: Argentina, Bahamas, Barbados, Belize, Bermuda, Brazil, Dominica, Dry Tortugas, Florida, Grenada, Guadeloupe, Jamaica, Martinique, Montserrat, Panama, Puerto Rico, St. Lucia, St. Vincent, Texas, Tobago, Trinidad. Bathymetric range - to 80 m.

Discussion: A small brittlestar that prefers soft substrate. So far, not found in large numbers in Texas waters. Hulings (1955) reported the species for shallow-water areas of northern Texas coast.

33. ***Amphipholis gracillima*** (Stimpson, 1852)

(Fig. 31)

Index of Synonyms: (1) *Ophiolepis gracillima* (2) *Amphiura gracillima* (3) *Amphipholis gracillima* (3a) *Amphiopholis gracillima* (4) *Amphipholis goesi* (5) *Micropholis gracillima* (6) *Microphiopholis gracillima*

References (index of synonyms): Clark, A. H. 1920 (3), 1922 (3), 1954 (3); Clark, A. M. 1970 (3); Clark, H. L. 1915 (3), 1919 (3), 1933 (3), 1933 (4), 1942 (3); Cubit & Williams 1983 (3); Dujardin & Hupé 1862 (1); Fell 1960 (3), 1962 (3); Hendler et al. 1995 (3); Hulings 1955 (3a); John & Clark 1954 (3); Kirby-Smith 1978 (3); Koehler 1914 (3); Ljungman 1866 (3); Lyman 1860 (2), 1865 (2), 1869 (2), 1875 (2), 1882 (2); Menzel 1971 (3); Pearse & Williams 1951 (3); Singletary 1980 (5); Singletary & Moore 1974 (5); Stimpson 1852 (1); Thomas 1962a (3), 1966 (5); Tommasi 1967 (5), 1970a (5); Turner 1985 (6); Verrill 1867 (2), 1899a (3).

Diagnosis: Disk with small, overlapping scales. Aboral arm plates undivided. Arm spines 3, same length as an arm segment. Oral papillae 6. Podial scales 2.

Description:

r: 2.5 mm.

R: up to 102 mm.

Disk surface: Covered with small, overlapping scales.

Radial shields: Exposed, 3 - 4X long as wide, rectangular, joined for entire length. Accessory plate at distal end of shield.

Aboral arm plates: Undivided, oval, 2X wide as long.

Supplementary arm plates: Absent.

Arm spines per side arm plate: 3 - 4, conical, 1X an arm segment.

Oral interbrachial surface: Same as disk.

Genital slits: 2 per interbrachium.

Number of oral papillae per jaw: 6, 3 per side.

Dental papillae: Absent.

Podial scales: 2, halfmoon-shaped, at right angles.

Color aboral surface: Disk and arms gray-tan.

Color oral surface: Off white.

Distribution: Belize, Bermuda, Brazil, Curaçao, Florida, Grenada, Panama, Puerto Rico,

South Carolina, St. John, St. Thomas, Texas, Tobago. Bathymetric range - to 25 m.

Discussion: Reported for northern Texas coast by Hulings (1955). Prefers soft substrate. There is a large amount of literature on this species in the 1980's and early 1990's under the genus name *Microphiopholis gracillima*. Hendler et al. (1995) rejected this genus and placed the species back in the genus *Amphipholis*.

34. *Hemipholis elongata* (Say, 1825)

(Fig. 32)

Index of Synonyms: (1) *Ophiura elongata* (2) *Ophiolepis elongata* (3) *Amphiura elongata* (4) *Asterias cordifera* (5) *Amphiura cordifera* (6) *Hemipholis cordifera* (7) *Hemipholis elongata*

References (index of synonyms): Armstrong 1987 (7); Boone 1933 (7); Britton & Morton 1989 (7); Clark, A. H. 1920 (7), 1939 (7), 1954 (7); Clark, H. L. 1915 (7), 1919 (7), 1933 (7); Cooley 1978 (7); Dujardin & Hupé 1862 (2), 1862 (3), 1862 (5); Fell 1960 (7); Harper 1970 (7); Hendler et al. 1995 (7); Holland et al. 1973 (7); Hulings 1955 (7); Ives 1889 (7); Johnson et al. 1974 (7); Kirby-Smith 1978 (7); Koehler 1907 (6), 1914 (7); Lima-Verde 1969 (7); Livingston 1984 (7); Ljungman 1866 (6); Ludwig 1882 (6), 1904 (6), 1904 (2); Lütken 1861 (3), 1861 (5); Lyman 1860 (1, 4, 5), 1860a (1, 5), 1865 (6), 1882 (6); Manso & Absalao 1988 (7); Menzel 1971 (7); Müller & Troschel 1842 (2); Parker 1956 (7), 1959 (7); Rathbun 1879 (6); Richmond 1962 (7); Say 1825 (1); Schwartz & Porter 1977 (7); Stancyk 1973 (7); Stimpson 1852 (2); Suarez 1974 (7); Thomas 1962a (7); Tommasi 1967 (7), 1970a (7), 1971 (7); Tommasi et al. 1988 (7); Tortonese 1934 (7); Verrill 1867 (6), 1899a (6); Whitten et al. 1950 (7).

Diagnosis: Disk with overlapping scales. Radial shields exposed. Aboral arm plates undivided. Arm spines 3, longer than an arm segment. Oral interbrachial surface naked. Oral papillae 3, 1 apical, often absent, and 1 at each distal angle of jaw. Podial scales 1.

Description:

r: 5 mm.

R: up to 95 mm.

Disk surface: Covered with medium-large scales mostly overlapping one another. Central scale distinct, encircled by 5 trapezoidal scales. A single column of 2 - 4 scales separate radial shields along most of their medial side. Interarm axis between radial shields has 5 - 7 columns of overlapping scales. A few scales between distal end of radial shields and

base of arm. Some of these scales may have a small conical spine.

Radial shields: Exposed, 1 x 2 mm, oval to egg-shaped - wider end distal, medial sides concave. Distal with white spot.

Aboral arm plates: Mainly undivided, a few may be cracked into 2 parts, oval-rectangular, 2.5X wide as long. Distal-medial edge may have shallow, concave notch. In small specimens, plates more fan-shaped without notch on distal edge.

Supplementary arm plates: Absent.

Arm spines per side arm plate: 3, conical, 1.5X arm segment, all same length.

Oral interbrachial surface: Naked, very distinct edge just oral to margin of disk where disk scales stop. Naked skin looks like it is embedded with minute marbles (in skin, not tuberculate on surface).

Genital slits: 2 per interbrachium.

Number of oral papillae per jaw: 3, 1 at apex, sometimes missing or sometimes cracked in 2 pieces, and 1 at each distal angle of jaw. Apex of jaw with large dental teeth.

Dental papillae: Absent.

Number of podial scales: 1, Oval.

Color aboral surface: Disk stone gray to olive-gray. Faint banding on arms.

Color oral surface: Off white.

Distribution: Brazil, Cuba, Florida, Georgia, Mississippi, North Carolina, Puerto Rico, South Carolina, Texas, Tobago, Trinidad. Bathymetric range - to 30 m.

Discussion: A small to medium-sized brittlestar that prefers soft substrate. Very common in near-shore waters and is one of the three most common brittlestars along the Texas coast.

35. *Ophiactis savignyi* (Müller & Troschel, 1842)

(Fig. 33)

Index of Synonyms: (1) *Ophiolepis savignyi* (2) *Ophiolepis sexradia* (2a) *Ophiolepis sexradiata* (3) *Ophiura savignyi* (4) *Ophiactis krebsii* (4a) *Ophiactis krebsi* (5) *Ophiactis virescens* (6) *Ophiactis reinhardtii* (7) *Ophiactis sexradia* (8) *Ophiactis brocki* (9)

Ophiactis savignyi (9a) *Ophiactis savignii*

References (index of synonyms): Amerson & Shelton 1976 (9); Bacallado et al. 1985 (9); Balinsky, J. 1957 (9); Bell 1884 (9), 1887 (9), 1888 (9a), 1889 (9a); Birkland et al. 1975 (9); Boone 1938 (8), 1938 (9); Brito 1960b (9), 1962 (9); Britton & Morton 1989 (9); Brock 1888 (9); Burfield 1924 (9); Burke 1974 (9), 1974a (9); Campbell 1988 (9); Cantera et al. 1987 (9), Caso 1951 (9), 1953 (9), 1961 (9), 1979 (9); Clark, A. H. 1920 (9), 1922 (9), 1939 (9), 1939a (9), 1952 (9), 1949 (9), 1954 (9), 1954a (9); Clark & Bowen 1949 (9); Clark, A. M. 1955 (9), 1965 (9), 1966 (9), 1980 (9), 1984 (9); Clark & Courtman-Stock 1976 (9); Clark & Rowe 1971 (9); Clark & Spencer-Davies 1965 (9); Clark, H. L. 1901a (4), 1914a (9), 1915 (9), 1917 (9), 1918a (9), 1919 (9), 1921a (9), 1922a (9), 1923 (9), 1925 (9), 1932 (9), 1933 (9), 1938 (9), 1939 (9), 1940 (9), 1942 (9), 1946 (9); Coleman 1946 (9); Cooley 1978 (9); Cubit & Williams 1983 (9); Day 1974 (9); Day & Morgans 1956 (9); Devaney 1974 (9), 1974a (9); Döderlein 1888 (9); Domantay & Domantay 1966 (9); Dubois 1975 (9); Dujardin & Hupé 1862 (1), 1862 (2a), 1862 (4, 5, 6); Duncan 1879 (7); Edmondson 1933 (9); Ely 1942 (9); Endean 1957 (9); Engel 1938 (9), 1939 (9); Fell 1960 (9); Fontaine 1953a (9); Gallaway & Lewbel 1982 (9); Gibbs et al. 1976 (9); Greeff 1882a (4a); Grube 1857 (2a), 1857a (2); Guille 1968 (9); Guille & Jangoux 1978 (9); Guille & Wolff 1984 (9); Heilprin 1888 (4); Hendler et al. 1995 (9); Hendler & Peck 1988 (9); Hopkins et al. 1977 (9); Hotchkiss 1982 (9); Hudson et al. 1970 (9); Hulings 1955 (9); Humphreys 1981 (9); Irimura 1969 (9), 1979 (9), 1981 (9); Ives 1889 (9); James 1986 (9); James & Pearse 1969 (9); John & Clark 1954 (9); Kalk 1958 (9); Koehler 1898 (7), 1904 (9), 1905 (9), 1905a (9), 1907 (9), 1913 (9), 1914 (9), 1922 (9), 1930 (9); Krau 1950 (9); Liao 1978 (9); Lima-Verde 1969 (9); Ljungman 1866 (4a, 5, 7, 9), 1871 (4a); de Loriol 1893 (7), 1893 (8); Ludwig 1882 (9), 1899 (9); Luederwaldt 1929 (9); Lütken 1856 (4a), 1856a (5), 1861 (4), 1861 (5), 1861 (6); Lütken & Mortensen 1899 (9); Lyman 1865 (4), 1865 (5), 1865 (7), 1869 (4), 1869 (5), 1879a (9), 1882 (4, 5, 6, 7, 9); Mabesoone & Coutinho 1970 (9); Macnae & Kalk 1962 (9); Madsen 1970 (9); Maluf 1988 (9); Manso & Absalao 1988 (9); Marktanner-Turneretscher 1887 (9); Matsumoto 1917 (9); McIntosh 1911 (9); McKnight 1972 (9); Menzel 1971 (9); Mortensen 1926 (9), 1933 (9), 1936 (9), 1940a (9); Müller & Troschel 1842 (1); Murakami 1942 (9), 1943 (9), 1944 (9), 1963 (9); Muscat 1980 (9); Nielsen 1932 (9); Parslow & Clark 1963 (9); Pawson 1978 (9), 1986 (9); Pearson 1936 (9); Price 1981 (9), 1982 (9), 1983 (9); Rathbun 1879 (4); de Roa 1967 (9); Sane & Chhapgar 1962 (9); Savigny 1809 (3); Sloan et al. 1979 (9); Stephenson et al. 1958 (9); Studer 1882 (2); Suarez 1974 (9); Tabb & Manning 1961 (9); Tommasi 1965 (9), 1967 (9), 1970a (9), 1971b (9); Tommasi & Aron 1988 (9); Tortonese 1934 (9), 1953 (9), 1953a (9), 1955 (9), 1957 (9), 1965 (9), 1966 (9), 1980 (9); Verrill 1867 (5), 1867 (4), 1868 (4), 1899a (4); Whitten et al. 1950 (9); Ziesenhenne 1937 (9).

Diagnosis: Disk with medium overlapping scales covered by a thin skin and usually a few small, conical spines. Arms often 6 in number. Aboral arm plates undivided, inflated, and tuberculate. Arm spines 5, about as long as an arm segment, stubby, and tuberculate.

Oral papillae 4, 2 at each distal corner of jaw. Podial scales 1. Small disk usually variegated green and white with a white spot on distal end of radial shields.

Description:

r: 2.5 mm.

R: 20.5 mm.

Disk surface: Covered with medium-sized overlapping scales and a thin skin making scales hard to see unless specimen is dry. Central scale may be evident, especially in juveniles, but pattern on rest of disk random. 3 - 5 columns of scales separating radial shields in interarm axis. A few short, conical spines are scattered on disk usually concentrated just proximal to radial shields and along edge of disk.

Radial shields: Exposed, 3X long as wide, oval to triangular-shaped - wider end distal. Distal end with distinct white spot.

Aboral arm plates: Undivided, rectangular with rounded corners, 1.5 – 2X wide as long. Plates swollen with distal-medial edge on many plates convex. Surface tuberculate.

Supplementary arm plates: Absent.

Arm spines per side arm plate: 4 - 6 (mostly 5), stubby, conical, tuberculate. Aboral most spine longest, 1 - 1.2X arm segment. Progressive decrease in size moving to oral side. Oral most spine, shortest, 0.33X arm segment or less.

Oral interbrachial surface: Small overlapping scales.

Genital slits: 2 per interbrachium.

Number of oral papillae per jaw: 4, 2 at each distal angle of jaw; rarely 1 or 3.

Dental papillae: Absent.

Podial scales: 1, oval to egg-shaped, distal end larger.

Color aboral surface: Disk variegated green-brown or yellow-brown and white. Variegation on arms often concentrated into irregular bands.

Color oral surface: Off white.

Distribution: Ambon, Andaman, Anguilla, Antigua, Aruba, Australia, Bahamas, Barbuda, Belize, Bermuda, Bonaire, Borneo, Brazil, Burma, California, Canary, Celebes, China, Clipperton, Cook, Cuba, Curaçao, Dry Tortugas, Egypt, Fiji, Florida, France,

Galapagos, Gilbert, Haiti, Hawaii, India, Israel, Jamaica, Japan, Johnston, Kenya, Korea, Lebanon, Madagascar, Maldive, Malpelo, Marquesas, Mascarene, Mexico, Mozambique, Nevis, Nicobar, Obi, Oman, Pakistan, Panama, P.D.R. of Yemen, Puerto Rico, Saba, São Tome, Saudi Arabia, Seychelles, Singapore, South Africa, South Carolina, Sri Lanka, St. Barthelemy, St. Croix, St. Eustatius, St. Helena, St. John, St. Martin, St. Thomas, Sudan, Tahiti, Talaud, Tanimbar, Texas, Tobago, Tortola, Trinidad, Tuamotu, Tuvalu, Venezuela, Wake, Zanzibar. Bathymetric range - to 160 m.

Discussion: One of the more ubiquitous brittlestars. Found on oil rigs in the Gulf of Mexico. This brittlestar undergoes fission, and most specimens are "halves" regenerating.

36. *Ophiocoma pumila* Lütken, 1861

(Fig. 34)

Index of Synonyms: (1) *Ophiocoma pumila* (1a) *Ophiocoma pumilla*

References (index of synonyms): Caycedo 1979 (1); Clark, A. H. 1920 (1), 1922 (1), 1939 (1), 1954 (1); Clark, A. M. 1955 (1); Clark, H. L. 1898 (1), 1899 (1), 1901 (1), 1901a (1), 1915 (1), 1919 (1), 1922a (1), 1933 (1), 1942 (1); Cubit & Williams 1983 (1); Devaney 1970 (1), 1974 (1); Dujardin & Hupé 1862 (1); Engel 1939 (1); Fontaine 1953a (1); Grave 1898 (1a); Greeff 1882a (1); Heilprin 1888 (1); Hendler et al. 1995 (1); Hendler & Peck 1988 (1); Hotchkiss 1982 (1); Ives 1889 (1); Koehler 1907 (1), 1913 (1), 1914 (1); Lewis & Bray 1983 (1); Ljungman 1866 (1), 1871 (1); Lütken 1861 (1); Lyman 1865 (1), 1875 (1), 1882 (1), 1883 (1a); Madsen 1970 (1); Parslow & Clark 1963 (1); Tommasi 1970a (1); Tommasi & Aron 1987 (1), 1988 (1); Tortonese 1934 (1); Verrill 1867 (1), 1899 (1).

Diagnosis: Disk covered with ovoid granules, color light brown. Aboral arm plates undivided and fan-shaped. Arm spines 4 on most segments, longer than an arm segment. Oral papillae 7. Dental papillae present. Podial scales 1.

Description:

r: 5.5 mm.

R: 60.5 mm (up to 150 mm).

Disk surface: Covered with ovoid rather than spherical granules, 50 - 70 mm^2.

Radial shields: Covered by granules.

Aboral arm plates: Undivided, broadly fan to oval, 1.5X wide as long. Distal side slightly

convex with lateral corners very rounded.

Supplementary arm plates: Absent.

Arm spines per side arm plate: 5 on first few proximal segments, 4 on rest, lanceolate to very elongate conical. Moving from aboral to oral - 1st: 1.5X arm segment, widest; 2nd: 2X arm segment, longest, almost as wide as first; 3rd: same length as first, more narrow than first and second; 4th: shortest, slightly shorter than third, most narrow. When 5, fifth same as fourth.

Oral interbrachial surface: Same as disk.

Genital slits: 2 per interbrachium.

Number of oral papillae per jaw: 7, 1 apical, 3 per side.

Dental papillae: Present.

Podial scales: 2 on first podia, 1 on rest, large oval.

Color aboral surface: Disk dark tan to light brown. Arms banded, light bands usually 2 segments wide, dark bands usually 1 segment wide.

Color oral surface: Off white.

Distribution: Anguilla, Antigua, Aruba, Azores, Bahamas, Barbados, Barbuda, Belize, Bermuda, Bonaire, Brazil, Cape Verde, Cuba, Curaçao, Dominica, Dry Tortugas, Florida, Grenada, Guadeloupe, Haiti, Jamaica, Martinique, Montserrat, Panama, Puerto Rico, São Tome, St. Barthelemy, St. Croix, St. John, St. Lucia, St. Martin, St. Thomas, St. Vincent, Texas, Tobago, Tortola, Trinidad. Bathymetric range - to 370 m.

Discussion: The specimen was in a bottle labeled *Ophioderma*, collected from the East Flower Garden Reef. I believe this is a first report for this species in the northern Gulf of Mexico.

37. *Ophiocoma wendtii* Müller & Troschel, 1842

(Fig. 35)

Index of Synonyms: (1) *Ophiocoma wendtii* (2) *Ophiocoma riisei* (2a) *Ophiocoma rusei* (2b) *Ophiocoma riseii* (3) *Ophiocoma wendti*

References (index of synonyms): Boone 1928 (2); Britton & Morton 1989 (3); Burke

1974 (3), 1974a (3); Caso 1961 (2); Caycedo 1979 (3); Clark, A. H. 1920 (2), 1922 (2), 1939 (2), 1954 (2); Clark, H. L. 1901a (2), 1915 (2), 1919 (2), 1921a (2), 1922a (2), 1933 (2), 1942 (2); Cubit & Williams 1983 (3); Devaney 1970 (3), 1974 (3); Dujardin & Hupé 1862 (1), 1862 (2a); Engel 1939 (2); Fontaine 1953a (2); Grave 1898 (2b); Hendler et al. 1995 (1); Hendler & Peck 1988 (3); Hotchkiss 1982 (2); Ives 1889 (2); Koehler 1907 (2), 1913 (2), 1914 (2); Lewis 1975 (2); Lewis & Bray 1983 (3); Ljungman 1866 (2), 1871 (3); Ludwig 1882 (2); Lütken 1861 (2); Lyman 1865 (2), 1869 (2), 1875 (2), 1882 (2); Müller & Troschel 1842 (1); Parslow & Clark 1963 (2); Pawson 1986 (3); Pearson 1936 (2); Rathbun 1879 (2); de Roa 1967 (2); Suarez 1974 (2); Tommasi 1966b (2), 1970a (2); Tommasi & Aron 1987 (2), 1988 (1); Tommasi et al. 1988 (2); Tortonese 1934 (2); Verrill 1867 (2), 1899 (2), 1899a (2); Voss & Voss 1955 (2).

Diagnosis: Disk covered with granules. Aboral arm plates undivided. Arm spines 3 - 4, longer than an arm segment. Oral papillae 9. Dental papillae present. Podial scales 1. Color brown-black aborally, rust orange orally.

Description:

r: 11.5 mm.

R: 183.5 mm.

Disk surface: Covered with granules, 36 - 49 mm^2.

Radial shields: Covered with granules.

Aboral arm plates: Undivided, oval with acute lateral ends, 2X wide as long.

Supplementary arm plates: Absent.

Arm spines per side arm plate: 3 - 4 alternating between segments along arm and on either side of the same segment, flattened conical. Aboral most longest, 5 - 6X an arm segment. Progressive decrease in size to oral most, shortest, 3 - 4X an arm segment.

Oral interbrachial surface: Medially and distally with granules similar to disk, laterally with naked small, overlapping scales.

Genital slits: 2 per interbrachium.

Number of oral papillae per jaw: 9, 3 apical, 3 per side.

Dental papillae: Present.

Podial scales: 2 on first 2 - 4 segments, 1 on rest, oval.

Color aboral surface: Disk and arms dark brown-black.

Color oral surface: Podia give surface rust-orange color.

Distribution: Aruba, Bahamas, Barbados, Belize, Bermuda, Bonaire, Brazil, Cuba, Curaçao, Dry Tortugas, Florida, Guadeloupe, Haiti, Jamaica, Mexico, Panama, Puerto Rico, Santanilla, St. Thomas, Texas, Tobago, Venezuela. Bathymetric range - to 25 m.

Discussion: A large, easily recognized brittlestar found on the Flower Garden reefs. One of the few ophiuroids in which color is a good diagnostic for identification. This species is one of the most common hard-bottom ophiuroids in the Caribbean region.

38. *Ophioderma appressum* (Say, 1825)
(Fig. 36)

Index of Synonyms: (1) *Ophiura appressa* (2) *Ophioderma virescens* (3) *Ophioderma appressa* (4) *Ophioderma appressum*

References (index of synonyms): Avent et al. 1977 (4); Boone 1933 (4); Brito 1962 (4); Burke 1974 (4), 1974a (4); Caso 1951 (4), 1953 (4), 1961 (3); Caycedo 1979 (4); Cherbonnier 1962 (4); Clark, A. H. 1920 (3), 1922 (3), 1939a (3), 1954 (4); Clark, H. L. 1898 (1), 1899 (1), 1901 (1), 1901a (1), 1915 (4), 1919 (4), 1933 (4), 1942 (4); Costa & Costa 1962 (4); Cubit & Williams 1983 (4); Defenbaugh 1976 (4); Devaney 1974 (4); Dubois 1975 (4); Engel 1939 (4); Fontaine 1953a (4); Grave 1898 (1); Hendler et al. 1995 (4); Hendler & Peck 1988 (4); Hotchkiss 1982 (4); Ives 1889 (1); Kirby-Smith 1978 (4); Koehler 1907 (3), 1913 (3), 1914 (3); Lima-Verde 1969 (4); Lewis & Bray 1983 (4); Ljungman 1866 (4), 1871 (4); Ludwig 1882 (3); Lütken 1861 (2); Lyman 1860 (1), 1860a (1), 1865 (1), 1869 (1), 1875 (1), 1882 (1); Mabesoone & Coutinho 1970 (4); Marktanner-Turneretscher 1887 (1); Parslow & Clark 1963 (4); Pawson 1986 (4); Pearson 1936 (4); Rathbun 1879 (1); de Roa 1967 (4); Say 1825 (1); Suarez 1974 (4); Thomas 1962 (4); Tommasi 1970a (3); Tommasi & Aron 1988 (3); Tortonese 1934 (3); Verrill 1867 (1), 1899 (1), 1899a (1); Voss & Voss 1955 (4); Ziesenhenne 1955 (4).

Diagnosis: Disk with granules. Radial shields covered by granules. Aboral arm plates undivided. Arm spines 8 - 10, shorter than an arm segment with oral most spine longest and widest. Oral papillae 18. Adoral shields partly or totally covered with granules. Genital slits 4 per interbrachium. Podial scales 2.

Description:

r: 9 mm.

R: up to 130 mm.

Disk surface: Covered by spherical granules, 180-200 mm^2. Disk granules extend on

lateral sides of first aboral arm plate forming U-shaped notch.

Radial shields: Covered by granules. Imprint of small ovals.

Aboral arm plates: Undivided, rectangular, 2X wide as long.

Supplementary arm plates: Absent.

Arm spines per side arm plate: 8 - 10, appressed, lanceolate, flat. Oral most arm spine longest and widest, 0.75 - 1X arm segment. Rest of arm spines same size, 0.5X arm segment.

Oral interbrachial surface: Same as disk.

Genital slits: 4 per interbrachium.

Number of oral papillae per jaw: 18 - 20, 9-10 per side.

Dental papillae: Absent.

Podial scales: 2, medial scale - oval, larger; lateral scale - triangular, shorter, overlapping base of oral most arm spine.

Color aboral surface: Disk usually gray-green. Arms banded, light bands usually 2 segments wide, dark bands usually 5 - 7 segments wide.

Color oral surface: Off white.

Distribution: Anguilla, Antigua, Aruba, Bahamas, Barbados, Barbuda, Belize, Bermuda, Bonaire, Brazil, Cuba, Curaçao, Dominica, Dry Tortugas, Florida, Grenada, Guadeloupe, Haiti, Jamaica, Martinique, Mexico, Montserrat, Panama, Puerto Rico, South Carolina, Santanilla, St. Barthelemy, St. Croix, St. John, St. Lucia, St. Martin, St. Thomas, St. Vincent, Texas, Tobago, Tortola, Trinidad, Venezuela. Bathymetric range - to 50 m.

Discussion: A common *Ophioderma* in the rest of the Caribbean. Occurs on the off-shore calcareous banks.

39. *Ophioderma brevispinum* (Say, 1825)

(Fig. 37)

Index of Synonyms: (1) *Ophiura brevispina* (2) *Ophiura olivacea* (2a) *Ophiura olivaceum* (3) *Ophiura serpens* (4) *Ophioderma brevispina* (4a) *Ophioderma brevispinum* (5) *Ophioderma olivaceum*

References (index of synonyms): Ayres 1852 (2a); Brooks & Grave 1899 (1); Cary 1906 (4); Cherbonnier 1959a (4); Clark, A. H. 1920 (4), 1954 (4a); Clark, H. L. 1901a (1), 1904 (1), 1915 (4a), 1919 (4a), 1933 (4a), 1941 (4a); Cooley 1978 (4a); Cubit & Williams 1983 (4a); Dragovich & Kelly 1964 (4a); Dubois 1975 (4a); Dujardin & Hupé 1862 (3); Fontaine 1953a (4a); Godcharles 1971 (4a); Godcharles & Jaap 1973 (4a); Grave 1898 (1); Gunter & Hall 1965 (4); Hendler et al. 1995 (4a); Hendler & Peck 1988 (4a); Hooks et al. 1976 (4a); Hotchkiss 1982 (4a); Hutton et al. 1956 (4a); Ives 1889 (1); Koehler 1907 (4), 1913 (4), 1914 (4); Ljungman 1866 (4), 1866 (5), 1871 (4); Ludwig 1882 (1); Lütken 1861 (3); Lyman 1865 (1), 1865 (2), 1869 (1), 1875 (1), 1882 (1), 1883 (1); McNulty et al. 1962 (4); Menzel 1971 (4a); Parslow & Clark 1963 (4a); Pearse 1936 (4); Pearson 1936 (4a); Rathbun 1879 (1); Say 1825 (1); Tabb et al. 1962 (4a); Tabb & Manning 1961 (4a); Thomas 1962 (4a); Tommasi 1970a (4); Verrill 1867 (1), 1899 (1); Wass 1965 (4a); Ziesenhenne 1955 (4a).

Diagnosis: Disk with granules. Radial shields covered by granules. Aboral arm plates undivided. Arm spines 7 - 9, shorter than an arm segment, same size. Oral papillae 16. Adoral shields not covered with granules. Genital slits 4 per interbrachium. Podial scales 2.

Description:

r: 6 mm.

R: 66 mm (up to 80 mm).

Disk surface: Covered with spherical granules, 144 - 160 mm^2. Disk granules extend on lateral sides of first and second aboral arm plates forming V-shaped notch.

Radial shields: Covered by granules. Imprint of small oval.

Aboral arm plates: Undivided, rectangular, 2X wide as long.

Supplementary arm plates: Absent.

Arm spines per side arm plate: 7 - 9, appressed, lanceolate, flat, 0.5 - 0.66X an arm segment, all same size.

Oral interbrachial surface: Same as disk.

Genital slits: 4 per interbrachium.

Number of oral papillae per jaw: 16, 8 per side.

Dental papillae: Absent.

Podial scales: 2, medial scale - oval, larger; lateral scale - quadrate-fan, shorter, extending to base of oral most arm spine.

Color aboral surface: Disk and arms usually variegated gray-green and white. Variegation on arms often in irregular bands.

Color oral surface: Off white.

Distribution: Aruba, Barbados, Belize, Brazil, Connecticut, Cuba, Dry Tortugas, Florida, French Guiana, Georgia, Haiti, Jamaica, Louisiana, Massachusetts, North Carolina, Panama, Puerto Rico, St. Croix, St. John, St. Thomas, Texas, Tortola. Bathymetric range - to 70 m.

Discussion: The most common *Ophioderma* in the northern Gulf of Mexico. This specimen was collected near the Flower Garden reefs.

40. *Ophioderma rubicundum* Lütken, 1856

(Fig. 38)

Index of Synonyms: (1) *Ophioderma rubicundum* (2) *Ophiura rubicunda* (3) *Ophioderma rubicunda*

References (index of synonyms): Burke 1974 (1), 1974a (1); Clark, A. H. 1920 (3), 1922 (3), 1939 (1), 1954 (1); Clark, H. L. 1901a (2), 1915 (1), 1919 (1), 1933 (1); Cubit & Williams 1983 (1); Devaney 1974 (1); Dujardin & Hupé 1862 (3); Engel 1939 (1); Fontaine 1953a (1); Hendler et al. 1995 (1); Hendler & Peck 1988 (1); Hotchkiss 1982 (1); Koehler 1907 (3), 1913 (3), 1914 (3); Lewis & Bray 1983 (1); Ljungman 1866 (1); Lütken 1856 (1), 1861 (3); Lyman 1860 (2), 1865 (2), 1869 (2), 1882 (2); Parker & Curray 1956 (1); de Roa 1967 (1); Suarez 1974 (1); Thomas 1962 (1); Tortonese 1934 (3); Verrill 1867 (2), 1899 (2), 1899a (2); Williams et al. 1983 (3); Ziesenhenne 1955 (1).

Diagnosis: Disk with granules. Radial shields exposed. Aboral arm plates undivided. Arm spines 8 - 10, 0.5X an arm segment, oral most spine longest and widest. Oral papillae 16. Adoral shields exposed. Genital slits 4 per interbrachium. Podial scales 2. Color red-purple and white.

Description:

r: 8 mm.

R: 106 mm (up to 140 mm).

Disk surface: Covered with spherical granules, 196 - 220 mm^2. Granules stop at base of arm, and overlapping scales extend on either side of first and second aboral arm plates.

Disk bulges on either side of arm where arm meets disk.

Radial shields: Exposed, (except in a few small specimens disk diameter < 6 mm), 0.5 x 1 mm, oval.

Aboral arm plates: Undivided, rectangular with rounded corners, 2X wide as long.

Supplementary arm plates: Absent.

Arm spines per side arm plate: 9 - 10 (7 - 8 in small specimens), lanceolate to conical, appressed. Oral most spine widest and longest, a little more than 0.5X arm segment. Rest 0.5X arm segment.

Oral interbrachial surface: Same as disk.

Genital slits: 4 per interbrachium.

Number of oral papillae per jaw: 16, 8 per side.

Dental papillae: Absent.

Podial scales: 2, medial scale – oval to egg-shaped, wide end distal, only slightly longer; lateral scale – quadrate-shaped, slightly wider.

Color aboral surface: Disk purple-red usually variegated with white. Arms with variegated bands, 2 - 3 segments mainly white, 3 - 4 segments mainly purple-red.

Color oral surface: Off white.

Distribution: Aruba, Bahamas, Barbados, Belize, Bonaire, Cuba, Curaçao, Dominican Republic, Dry Tortugas, Florida, Guadeloupe, Jamaica, Panama, Puerto Rico, St. Thomas, Texas, Tobago, Trinidad, Venezuela. Bathymetric range - to 70 m.

Discussion: Collected at the Flower Garden reefs. This species is normally found inside the reef structure during the day and is usually only collected by chemical infusion into the reef.

41. *Ophioderma squamosissimum* Lütken, 1856

(Fig. 39)

Index of Synonyms: (1) *Ophioderma squamosissimum* (2) *Ophiura squamosissima* (3) *Ophioderma squamosissima*

References (index of synonyms): Burke 1974 (1), 1974a (1); Clark, A. H. 1920 (3);

Clark, H. L. 1915 (1), 1918a (1), 1919 (1), 1933 (1); Dubois 1975 (1); Dujardin & Hupé 1862 (3); Godcharles & Jaap 1973 (1); Hendler et al. 1995 (1); Hendler & Peck 1988 (1); Hotchkiss 1982 (1); Ljungman 1866 (1); Lütken 1856 (1), 1861 (3); Lyman 1860 (2), 1865 (2), 1869 (2), 1882 (2); Suarez 1974 (1); Thomas 1962 (1); Verrill 1867 (2), 1899a (2); Ziesenhenne 1955 (1).

Diagnosis: Disk covered with flattened granules usually not covering all radial shields. Aboral arm plates divided into 7 pieces. Arm spines 6 - 8, nearly rectangular, about 1X arm segment. Oral papillae 16 - 18. Genital slits 4 per interbrachium. Podial scales 2. Color bright orange-red.

Description:

r: 23 mm.

R: 283 mm.

Disk surface: Covered by flattened granules resembling cobble stones. Granules in center of disk smaller, 64 - 70 mm^2; increasing in size near edge of disk, 25 - 30 mm^2.

Radial shields: Some exposed, some covered by disk granules, 2.5 mm long, oval to egg-shaped - wider end distal.

Aboral arm plates: Divided into 7 pieces that slightly overlap next plate. Medial piece trapezoidal - wider base proximal, scalloped into 3 sections. 3 pieces on each side of medial piece hexagonal - long axis oriented in medial-lateral direction. Side pieces placed end to end form slightly diagonal band that extends two-thirds around arm placing side arm plates with spines in almost an oral position.

Supplementary arm plates: Absent.

Arm spines per side arm plate: 6 - 8, appressed. Aborally, spines somewhat conical with blunt tips. Orally, becoming more rectangular. Oral most spine slightly wider than rest, almost perfectly rectangular. Aboral most spine 0.75 - 1.0X arm segment. A slight increase in size to most oral spine, longest and widest, 1X arm segment.

Oral interbrachial surface: Same as disk.

Genital slits: 4 per interbrachium. Distal 2 separated from base of arm by wedge of about 5 - 10 highly overlapped scales, extending from sixth to seventh side arm plate with spines.

Number of oral papillae per jaw: 16 - 18, 8 - 9 per side.

Dental papillae: Absent.

Podial scales: 2, medial scale - oval, longer, almost as long as an oral arm plate; lateral scale – fan- shaped, shorter but wider at distal end, overlapping base of most oral arm spine.

Color aboral surface: Disk and arms bright orange-red.

Color oral surface: Lighter shade of red to light yellow.

Distribution: Belize, Cuba, Florida, Texas, Tobago, Trinidad. Bathymetric range - to 80 m.

Discussion: One of the more rarely collected species, and it is interesting that it should be found in the Flower Garden reefs. *O. squamosissimum* quickly loses its bright orange diagnostic color when preserved in alcohol.

42. *Ophiolepis elegans* Lütken, 1861

(Fig. 40)

Index of Synonyms: (1) *Ophiolepis elegans*

References (index of synonyms): Boone 1933 (1); Britton & Morton 1989 (1); Caso 1979 (1); Cherbonnier 1959a (1); Clark, A. H. 1920 (1), 1939 (1), 1954 (1); Clark, H. L. 1901a (1), 1915 (1), 1919 (1), 1933 (1), 1941 (1); Cooley 1978 (1); Defenbaugh 1976 (1); Dragovich & Kelly 1964 (1); Dubois 1975 (1); Dujardin & Hupé 1862 (1); Fontaine 1953a (1); Godcharles 1971 (1); Godcharles & Jaap 1973 (1); Grave 1898 (1); Gunter & Hall 1965 (1); Hendler 1988 (1); Hendler et al. 1995 (1); Hildebrand 1954 (1); Hooks et al. 1976 (1); Hopkins 1979 (1); Hutton et al. 1956; Ives 1889 (1); John & Clark 1954 (1); Jolley 1972 (1); Kirby-Smith 1978 (1); Koehler 1913 (1), 1914 (1); Ljungman 1866 (1), 1871 (1); Lütken 1861 (1); Lyman 1865 (1), 1869 (1), 1875 (1), 1882 (1); Lyons et al. 1971 (1); Menzel 1971 (1); Parker 1956 (1), 1959 (1); de Roa 1967 (1); Stancyk 1973 (1); Suarez 1974 (1); Tabb & Manning 1961 (1); Tabb et al. 1962 (1); Verrill 1867 (1); Wilson 1900 (1); Zieman & Zieman 1989 (1).

Diagnosis: Disk with non-overlapping scales of 2 distinct sizes formed in rosette pattern. Radial shields exposed and large. 1 column of large scales between radial shields in interarm axis. Aboral arm plates undivided. Arm spines 4 - 5, less than an arm segment. Oral papillae 10. Podial scales 2.

Description:

r: 12 mm.

R: 95 mm.

Disk surface: Flat, covered with non-overlapping scales in 2 distinct sizes. Larger scales in rosette pattern, with each large scale encircled by 20 - 24 small, brick-like scales. Large scales approximately 4X small scales. 1 column of large scales between radial shields along arm axis and interarm axis.

Radial shields: Exposed, large, 3 x 5 mm, roughly egg-shaped - wider end distal.

Aboral arm plates: Undivided, with few plates split in half, rectangular-hexagonal, 2X wide as long.

Supplementary arm plates: Present, often broken into 2 - 3 pieces.

Arm spines per side arm plate: 4 - 6 (most with 5), conical. Aboral most and oral most slightly shorter than middle spines. Middle spines 0.5X an arm segment.

Oral interbrachial surface: Each edge of interbrachial surface next to arms has 4 scales. Disk edge of interbrachial surface has 2 large (2 - 3 mm) hemispherical scales that project slightly beyond edge of disk and occupy both oral and side surface of disk. Rest of interbrachial surface covered by randomly aligned and geometrically shaped scales forming a shattered glass pattern.

Genital slits: 2 per interbrachium.

Number of oral papillae per jaw: 10 - 12, 5 - 6 per side.

Dental papillae: Absent.

Podial scales: 2, (rarely 3 on some proximal segments), medial scale – fan-shaped, larger; lateral scale – oval to fan-shaped, smaller.

Color aboral surface: Disk olive-gray. Arms faintly to strongly banded, light bands 3 - 4 segments wide, dark bands 1 - 2 segments wide.

Color oral surface: Off white.

Distribution: Alabama, Antigua, Barbados, Barbuda, Cuba, Dominica, Dry Tortugas, Florida, French Guiana, Grenada, Guadeloupe, Jamaica, Martinique, Mexico, Mississippi, Montserrat, North Carolina, Puerto Rico, South Carolina, St. Croix, St. John, St. Lucia, St. Thomas, St. Vincent, Texas, Venezuela. Bathymetric range - to 80 m.

Discussion: One of the easiest brittlestars to recognize, even in the field, because of the

plate formation on the disk. This species is very numerous on the sandy bottoms and is one of the three most common brittlestars along the Texas coast. Almost all of the specimens examined had the arm tips broken off to some degree, or the arms were obviously regenerated. This species is probably a food item for carnivores of the sandy bottom community.

43. *Ophiolepis impressa* Lütken, 1861

(Fig. 41)

Index of Synonyms: (1) *Ophiolepis impressa* (2) *Ophiozona impressa*

References (index of synonyms): Brito 1962 (2); Clark, A. H. 1920 (2), 1922 (2), 1954 (2); Clark, H. L. 1901a (2), 1915 (2), 1919 (2), 1933 (2); Cubit & Williams 1983 (2); Devaney 1974 (1); Dujardin & Hupé 1862 (1); Engel 1939 (2); Fell 1960 (2); Fontaine 1953a (2); Grave 1898 (1); Hendler et al. 1995 (1); Hendler & Peck 1988 (1); Hulings 1955 (2); Koehler 1907 (2), 1913 (2), 1914 (2); Lewis 1965 (2); Ljungman 1866 (1); Lütken 1861 (1); Lyman 1865 (2), 1869 (2), 1875 (2), 1882 (2), 1883 (2); Mabesoone & Coutinho 1970 (2); Matsumoto 1915 (2), 1917 (2); Pearson 1936 (2); de Roa 1967 (2); Tommasi & Aron 1988 (2); Tortonese 1934 (2); Verrill 1867 (2), 1899 (2), 1899a (2); Williams et al. 1983 (2).

Diagnosis: Disk with partially overlapping, pebble-like scales in 2 distinct sizes. Radial shields exposed. More than 1 column of large scales between radial shields in interarm axis. Aboral arm plates undivided. Arm spines 3 - 4, 1X an arm segment. Oral papillae 11. Podial scales 2.

Description:

r: 6.5 mm.

R: 71.5 mm.

Disk surface: Covered with large and small partially overlapping scales. Scales inflated, especially distal edge, giving surface pebbled appearance. Large scales form circular pattern, incompletely encircled by smaller scales. 5 columns of large scales between radial shields in interarm axis; 1 column of large scales between radial shields in arm axis.

Radial shields: Exposed, 3 x 1 mm, oval to triangular-shaped - wider end distal.

Aboral arm plates: Undivided, trapezoidal - wider base distal. Proximal plates wider than

long. Distal plates longer than wide.

Supplementary arm plates: Present, very small on lateral corners of first few plates.

Arm spines per side arm plate: 4 - 5 proximal and 3 distal, lanceolate-conical, 1X an arm segment.

Oral interbrachial surface: 7 - 9 columns of overlapping, flattened scales. Scales not as distinctly different in size as on disk surface. Genital slits bordered by 4 - 5 very narrow scales.

Genital slits: 2 per interbrachium.

Number of oral papillae per jaw: 11, 1 apical, 5 per side.

Dental papillae: Absent.

Podial scales: 2, medial scale – triangular-shaped; lateral scale – oval to halfmoon-shaped.

Color aboral surface: Disk light brown. Arms banded, light and dark bands 2 - 3 segments wide.

Color oral surface: Off white.

Distribution: Bahamas, Barbados, Belize, Bermuda, Brazil, Cuba, Curaçao, Dominica, Dominican Republic, Dry Tortugas, Florida, Grenada, Guadeloupe, Jamaica, Martinique, Montserrat, Panama, Puerto Rico, St. Croix, St. John, St. Lucia, St. Thomas, St. Vincent, Texas, Tobago, Trinidad, Venezuela. Bathymetric range - to 150 m.

Discussion: Reported for northern Texas coast by Hulings (1955).

44. ***Ophionereis reticulata*** (Say, 1825)

(Fig. 42)

Index of Synonyms: (1) *Ophiura reticulata* (2) *Ophiolepis reticulata* (3) *Ophiocoma reticulata* (4) *Ophiolepis nereis* (5) *Amphiura stearnsi* (6) *Ophionereis reticulata*

References (index of synonyms): Avent et al. 1977 (6); Brito 1960b (6), 1962 (6); Burke 1974 (6), 1974a (6); Clark, A. H. 1920 (6), 1922 (6), 1939 (6), 1954 (6); Clark, A. M. 1953 (6); Clark, H. L. 1898 (6), 1899 (6), 1901 (6), 1901a (6), 1915 (6), 1919 (6), 1933 (6), 1942 (6); Cooley 1978 (6); Cubit & Williams 1983 (6); Devaney 1974 (6); Dubois 1975 (6); Dujardin & Hupé 1862 (2), 1862 (6); Engel 1939 (6); Fell 1960 (6); Fontaine 1953a (6); Godcharles & Jaap 1973 (6); Grave 1898 (6); Heilprin 1888 (6);

Hendler et al. 1995 (6); Hendler & Peck 1988 (6); Hotchkiss 1982 (6); Ives 1889 (6), 1891 (5); Koehler 1907 (6), 1909 (6), 1913 (6), 1914 (6); Lewis & Bray 1983 (6); Lima-Verde 1969 (6); Ljungman 1866 (6), 1871 (6); Ludwig 1882 (6); Lütken 1856 (4), 1859a (3), 1861 (6); Lyman 1860a (1, 6), 1865 (6), 1869 (6), 1875 (6), 1879 (6), 1882 (6), 1883 (6); Mabesoone & Coutinho 1970 (6); Madsen 1970 (6); Marktanner-Turneretscher 1887 (6); McNulty et al. 1962 (6); Millott 1953 (6); Müller & Troschel 1842 (2); Parslow & Clark 1963 (6); Pawson 1986 (6); Pearse & Williams 1951 (6); Rathbun 1879 (6); de Roa 1967 (6, *O. olivacea* non Clark, H. 1901); Say 1825 (1); Suarez 1974 (6); Tabb & Manning 1961 (6); Thomas 1973 (6); Tommasi 1970a (6); Tommasi & Aron 1988 (6); Tortonese 1934 (6); Verrill 1867 (6), 1868 (6), 1899 (6), 1899a (6).

Diagnosis: Disk with very small overlapping scales. Radial shields exposed but very small. Aboral arm plates undivided. Arm spines 3, longer than an arm segment. Oral papillae 10. Podial scale 1. Network of brown lines forms net-like pattern on disk. Arms white with brown bands.

Description:

r: 6 mm.

R: Up to 130 mm.

Disk surface: Covered with very small overlapping scales. Network of dark lines on disk does not outline individual scales.

Radial shields: Exposed, narrow, <1 mm in length, cigar-shaped.

Aboral arm plates: Undivided, trapezoidal - wider base proximal.

Supplementary arm plates: Present, large rounded-triangular - point medial, base lateral.

Arm spines per side arm plate: 3, lanceolate with rounded tip. On smaller specimens spines more conical, becoming flatter on larger specimens. Middle arm spine longest, 1.5 - 2X arm segment. Aboral and oral most spines same size, slightly shorter than middle arm spine.

Oral interbrachial surface: Same as disk.

Genital slits: 2 per interbrachium. Interbrachial edge of each slit lined with larger plates that have small, oval papillae.

Number of oral papillae per jaw: 10, 5 per side.

Dental papillae: Absent.

Podial scales: 1, large, circular.

Color aboral surface: Disk bone white to gray-white with network of brown lines forming fish-net pattern on disk. Arms white with brown bands. Brown bands usually 1 segment wide separated by 3 - 4 segments of white.

Color oral surface: Off white. Oral arm plate that corresponds to brown aboral arm plate often brown, especially in small specimens.

Distribution: Anguilla, Antigua, Aruba, Bahamas, Barbados, Barbuda, Belize, Bermuda, Bonaire, Brazil, Cuba, Curaçao, Dominica, Dry Tortugas, Florida, Grenada, Guadeloupe, Haiti, Jamaica, Martinique, Montserrat, Panama, Puerto Rico, South Carolina, St. Barthelemy, St. Croix, St. John, St. Lucia, St. Martin, St. Thomas, St. Vincent, Texas, Tobago, Trinidad, Venezuela. West Africa? Bathymetric range - to 220 m.

Discussion: Specimens were collected on the calcareous bank Seven and One-Half Fathom Reef. This ophiuroid is usually found in rock crevices.

45. *Ophiophragmus moorei* Thomas, 1965

(Fig. 43)

Index of Synonyms: (1) *Ophiophragmus moorei*

References (index of synonyms): Alexander & Haburay 1977 (1); Behre 1950 (*O. brachyactis* non Clark, H. L. 1915); Moore 1962 (*O. wurdemani* non Lyman 1860); Shelton & Robertson 1981 (1); Thomas 1965 (1).

Diagnosis: Disk with overlapping scales and spines along margin. Spines 0.5X length of radial shields. Radial shields exposed. Aboral arm plates undivided. Arm spines 3, 1.2X an arm segment. Oral papillae 6. Podial scales 2.

Description:

r: 6 mm.

R: up to 116 mm.

Disk surface: Small specimens with distinct central scale and 4 concentric circles of scales forming rosette pattern. In larger specimens, rosette pattern not as distinct. Disk has conical spines along entire margin. Spines 0.33 - 0.5X radial shield length, appressed but free to move.

Radial shields: Exposed, 1 x 2 mm, triangular to egg-shaped - wider end distal. Shields

separated for one half of length proximally, in contact distally. Small accessory plate distal to shield.

Aboral arm plates: Undivided, trapezoidal-rectangular, 2X wide as long.

Supplementary arm plates: Absent.

Arm spines per side arm plate: 3, conical, somewhat flattened, 1.2X an arm segment. Middle spine slightly shorter than aboral and oral most spines.

Oral interbrachial surface: Finely scaled.

Genital slits: 2 per interbrachium.

Number of oral papillae per jaw: 6, 3 per side.

Dental papillae: Absent.

Podial scales: 2, proximal scale - oval, smaller; distal scale – halfmoon to fan-shaped, larger.

Color aboral surface: Disk gray-brown. Arms banded, light bands 1 - 4 segments wide, dark bands 3 - 4 segments wide.

Color oral surface: Mostly off white; oral arm plates darkly pigmented. In small specimens, oral shields not containing madreporite may be brown.

Distribution: Florida, Louisiana, Mississippi, Texas. Bathymetric range - to 10 m.

Discussion: One of the few brittlestars endemic to northern Gulf of Mexico. This species prefers soft substrate.

46. *Ophiostigma isocanthum* (Say, 1852)

(Fig. 44)

Index of Synonyms: (1) *Ophiura isocantha* (1a) *Ophiura isacantha* (2) *Ophiocoma isacantha* (3) *Ophiostigma moniliforme* (3a) *Ophiostigma moniliformes* (4) *Ophiostigma isacantha* (5) *Ophiostigma isacanthum* (5a) *Ophiostigma isocanthum*

References (index of synonyms): Clark, A. H. 1920 (5), 1922 (5), 1939 (5), 1954 (5); Clark, H. L. 1898 (4), 1899 (4); 1901 (4), 1901a (5), 1915 (5), 1919 (5), 1933 (5), 1942 (5); Cooley 1978 (5); Dubois 1975 (5); Dujardin & Hupé 1862 (3a); Engel 1939 (5); Fontaine 1953a (5); Heilprin 1888 (4); Hendler et al. 1995 (5a); Hendler & Peck 1988 (5a); Ives 1889 (5); Koehler 1907 (5), 1913 (5), 1914 (5); Lewis 1965 (5); Ljungman 1866 (5a), 1871 (5); Ludwig 1882 (5); Lütken 1861 (3); Lyman 1860a (1a, 4), 1865 (5),

1869 (5), 1875 (5), 1879 (5), 1882 (5), 1883 (5); Manso 1988 (5); McNulty et al. 1962 (5); Müller & Troschel 1842 (2); Parslow & Clark 1963 (5); Pearson 1936 (5); Rathbun 1879 (5); Say 1825 (1); Tabb & Manning 1961 (5); Thomas 1962a (5); Tommasi 1970a (5); Tommasi & Aron 1987 (5), 1988 (5); Verrill 1867 (5), 1899a (5).

Diagnosis: Disk covered with papillae-like spines that usually conceal the disk scales underneath. Radial shields often partially covered. Aboral arm plates undivided, rounded-trapezoidal. Adoral shields touching one another at both ends. Arm spines 3, slightly shorter than an arm segment. Oral papillae 6, with distal one distinctly largest. Podial scales 2, small. Arms 5.

Description:

r: 3 mm.

R: 29 mm.

Disk surface: Covered with papillae-like spines.

Radial shields: Partially covered, 3X long as wide, rectangular. Shields separated for three-fourths of length proximally, in contact distally. Proximal end of shields often covered with disk spines. Distal end of each shield has small, lobe-like accessory plate.

Aboral arm plates: Undivided, rounded trapezoidal. Distal edge convex. On most of arm, distal side of one plate comes to proximal side of next plate.

Supplementary arm plates: Absent.

Arm spines per side arm plate: 3, conical, 0.75X arm segment, all same size.

Oral interbrachial surface: Same as disk.

Genital slits: 2 per interbrachium.

Number of oral papillae per jaw: 6, 3 per side.

Dental papillae: Absent.

Podial scales: 2, small, oval-rectangular, same size.

Color aboral surface: Disk and arms gray-tan.

Color oral surface: Off white.

Distribution: Barbados, Belize, Bermuda, Brazil, Curaçao, Dry Tortugas, Florida, Grenada, Jamaica, Puerto Rico, St. Thomas, Texas, Trinidad. Bathymetric range - to 244 m.

Discussion: This species is one of the many small amphiurid brittlestars usually found on soft bottoms. It has not been found in large numbers in Texas waters.

47. *Ophiostigma siva* (Say, 1852)

(Fig. 45)

Index of Synonyms: (1) *Ophiostigma siva*

References (index of synonyms): Hendler 1995 (1); Hendler et al. 1995 (1).

Diagnosis: Disk loosely covered with papillae-like spines that usually conceal the disk scales underneath. Radial shields exposed. Aboral arm plates undivided and fan to egg-shaped. Adoral shields not touching at first ventral arm plate. Arm spines 3, slightly shorter than an arm segment. Oral papillae 6, with distal one distinctly largest. Podial scales 2, small. Arms usually 6, sometimes 5.

Description:

r: 2 mm.

R: 28 mm.

Disk surface: Covered, not densely, with papillae-like spines.

Radial shields: Exposed, at least the distal ends, 3X long as wide, rectangular. Proximal end of shields often covered with disk spines. Distal end of each shield has small, lobe-like accessory plate.

Aboral arm plates: Undivided, fan to egg-shaped. Distal edge convex. Close to disk, distal side of one plate comes to proximal side of next plate. On rest of arm, side arm plates meet medially, completely separating aboral arm plates from one another. Side arm plates large, conspicuous when viewed from above.

Supplementary arm plates: Absent.

Arm spines per side arm plate: 3, conical, 0.75X arm segment, all same size.

Oral interbrachial surface: Same as disk.

Genital slits: 2 per interbrachium.

Number of oral papillae per jaw: 6, 3 per side.

Dental papillae: Absent.

Podial scales: 2, small, oval-rectangular, same size.

Color aboral surface: Disk and arms gray-tan.

Color oral surface: Off white.

Distribution: Belize, Bermuda, Dry Tortugas, Florida, Jamaica, Puerto Rico, St. Thomas, Texas. Bathymetric range - to 42 m.

Discussion: The specimen examined from the Texas A&M oceanography collection was an unusual five armed specimen of this normally six armed species. The shape and placement of the aboral arm plates, side arm plates, ventral arm plates, and adoral shields all match perfectly with the description of this species, and Hendler (1995) reports the occurrence of some five armed specimens in most collections.

48. *Ophiothrix (Ophiothrix) angulata* (Say, 1825)

(Fig. 46)

Index of Synonyms: (1) *Ophiura angulata* (2) *Ophiothrix angulata* (2a) *Ophiothrix (Ophiothrix) angulata* (3) *Ophiothrix violacea* (4) *Ophiothrix hispida*

References (index of synonyms): Avent et al. 1977 (2); Ayres 1852b (4); Boone 1928 (2), 1933 (2); Brito 1960b (3), 1962 (3); Britton & Morton 1989 (2); Burke 1974 (2); Caso 1961 (2), 1979 (2); Clark, A. H. 1920 (2), 1922 (2), 1939 (2); 1954 (2); Clark, A. M. 1965 (2), 1967 (2a); Clark, H. L. 1901a (2), 1914a (2), 1915 (2), 1918a (2), 1919 (2), 1922a (2), 1933 (2), 1941 (2); Cooley 1978 (2); Coues & Yarrow 1878 (2); Cubit & Williams 1983 (2); Defenbaugh 1976 (2); Devaney 1974 (2a); Dragovich & Kelly 1964 (2); Dubois 1975 (2); Dujardin & Hupé 1862 (3); Engel 1939 (2); Fontaine 1953a (2); Godcharles & Jaap 1973 (2); Hendler et al. 1995 (2); Hendler & Peck 1988 (2); Hooks et al. 1976 (2); Hopkins 1979 (2); Hopkins et al. 1977 (2); Hotchkiss 1982 (2a); Hulings 1955 (2); Hutton et al. 1956 (2); Ives 1889 (2), 1890 (2); Johnson et al. 1974 (2); Kirby-Smith 1978 (2); Koehler 1907 (2), 1913 (2), 1914 (2); Krau 1950 (2); Lewis & Bray 1973 (2); Ljungman 1866 (2, 3); Lima-Verde 1969 (2); Livingston 1984 (2); Ludwig 1882 (2); Luederwaldt 1929 (2); Lütken 1861 (3); Lyman 1860 (2, 3), 1860a (1, 2), 1865 (2), 1865 (3), 1869 (3), 1875 (3), 1882 (2), 1883 (2); Lyons et al. 1971 (2); Mabesoone & Coutinho 1970 (3); Manso & Absalao 1988 (2); Marktanner-Turneretscher 1887 (2); Menzel 1971 (2); Müller & Troschel 1842 (3); Parker 1959 (2); Parslow & Clark 1963 (2); Pearse 1936 (2); Pearse & Williams 1951 (2); Pearson 1936 (2); Rathbun 1879 (3); de Roa 1967 (2); Say 1825 (1); Stancyk 1973 (2); Suarez 1974 (2); Tabb & Manning 1961 (2); Tommasi 1966b (2), 1967 (2), 1970a (2), 1971a (2), 1971b (2); Tommasi & Aron 1987 (2), 1988 (2); Tortonese 1934 (2), 1934 (3); Verrill 1867 (3), 1872 (2), 1899 (2), 1899a (2); Wass 1965 (2); Wilson 1900 (2).

Diagnosis: Disk covered with short spines usually having bifid or trifid ends. Radial shields exposed; proximal part of radial shields may be covered by disk spines. Aboral arm plates undivided, diamond-shaped. Arm spines 6, aboral spines longer than an arm segment, glassy in appearance. No oral papillae. Dental papillae present. Podial scale 1, very small. White stripe bordered by dark at least on tips of arms.

Description:

r: 6 mm.

R: 48 mm (up to 80).

Disk surface: Covered with short spines, except distal end of radial shields. Spines may have single, bi, or tri-forked ends. Most spines similar or smaller in size to shortest arm spine. A few, to many, near size of larger arm spines.

Radial shields: Exposed, 2 - 3 x 1 mm, oval to triangular-shaped - wider end distal. In contact along complete length.

Aboral arm plates: Undivided, diamond-shaped - all sides concave.

Supplementary arm plates: Absent.

Arm spines per side arm plate: 6, sparingly serrate, flat, glassy in appearance. Oral most spine may have curved end. Aboral most spine longest, 3 - 4X an arm segment. Progressive decrease in size to oral most spine, shortest, 0.5X arm segment.

Oral interbrachial surface: Mostly naked, some with spines medially near edge of disk.

Genital slits: 2 per interbrachium.

Number of oral papillae per jaw: Absent.

Dental papillae: Present.

Podial scales: 1, minute, lanceolate.

Color aboral surface: Various - disk brown, dark purple, reddish purple, or rust red. Arms usually same ground color with white stripe bordered by dark stripes running length of arm. Stripes sometimes only evident near distal tip of arm.

Color oral surface: Off white.

Distribution: Alabama, Anguilla, Antigua, Aruba, Bahamas, Barbados, Belize, Bermuda, Bonaire, Brazil, Cuba, Curaçao, Dominica, Dry Tortugas, Florida, Georgia, Grenada,

Guadeloupe, Haiti, Jamaica, Martinique, Mexico, Mississippi, Montserrat, North Carolina, Panama, Puerto Rico, South Carolina, St. Barthelemy, St. Croix, St. John, St. Lucia, St. Martin, St. Thomas, St. Vincent, Texas, Tobago, Tortola, Trinidad, Venezuela, Virginia. Bathymetric range - to 520 m.

Discussion: Fairly common in oyster rubble in south Texas. Specifically collected in the rubble of the old pilot house of the U.S. Coast Guard Station, Brazos-Santiago Pass.

49. *Ophiothrix (Acanthophiothrix) suensonii* Lütken, 1856
(Fig. 47)

Index of Synonyms: (1) *Ophiothrix suensonii* (1a) *Ophiothrix suensoni* (1b) *Ophiothrix (Acanthophiothrix) suensoni* (2) *Placophiothrix suensonii*

References (index of synonyms): Bertsch 1987 (1a); Boone 1933 (1); Britton & Morton 1989 (1); Caycedo 1979 (1); Clark, A. H. 1920 (1), 1922 (1), 1939 (1), 1954 (1); Clark, A. M. 1967 (1b); Clark, H. L. 1901a (1), 1915 (1), 1918a (1), 1919 (1), 1922a (1), 1933 (1), 1941 (2), 1942 (1); Cubit & Williams 1983 (1); Devaney 1974 (1b); Dubois 1975 (1); Dujardin & Hupé 1862 (1); Engel 1927 (1); Fontaine 1953a (1); Hendler et al. 1995 (1); Hendler & Peck 1988 (1a); Hopkins et al. 1977 (1a); Hotchkiss 1982 (1b); Ives 1889 (1); Koehler 1907 (1), 1913 (1), 1914 (1); Ljungman 1866 (1a), 1871 (1a); Lütken 1856 (1), 1861 (1); Lyman 1865 (1), 1869 (1), 1875 (1), 1879 (1), 1879a (1), 1882 (1), 1883 (1); Parslow & Clark 1963 (1a); Rathbun 1879 (1); Tommasi 1970a (1a), 1971a (1a); Verrill 1899 (1); Williams et al. 1983 (1a).

Diagnosis: Disk with a few very long spines. Radial shields exposed, taking up most of disk. Aboral arm plate undivided and fan-shaped. Arm spines 4 - 6, glassy, aboral spines much longer than an arm segment. No oral papillae. Dental papillae present. Podial scale 1, very small. Dark purple to black stripe bordered by white stripes on arms, with dark stripe extending onto disk.

Description:

r: 4 mm.

R: up to 130 mm.

Disk surface: Very large radial shields take up most of surface. Between radial shields in arm axis, in interarm axis, and in disk center a few (20 - 30 on whole disk) very long spines, almost equal to radius of disk in length. About 7 enlarged scales border distal

edge of radial shields.

Radial shields: Exposed, large, 2 x 3 mm, triangular - apex lateral, base medial. Shields separated by small gap along entire length.

Aboral arm plates: Undivided, fan-shaped - broad end proximal. Difficult to distinguish due to spines and dark stripe on arm.

Supplementary arm plates: Absent.

Arm spines per side arm plate: 4 - 6, sparingly serrate, flat to oval, glassy in appearance. Aboral most spine longest, 6 - 7X an arm segment. Progressive decrease in size to oral most spine, shortest, 0.33X arm segment and often curved into a hook.

Oral interbrachial surface: Finely scaled.

Genital slits: 2 per interbrachium.

Number of oral papillae per jaw: Absent.

Dental papillae: Present.

Podial scales: 1, minute, lanceolate.

Color aboral surface: Disk usually dark brown to purple-brown. Arms same ground color with dark purple to black stripe down entire length of arm. Dark stripe continues onto disk between radial shields meeting in disk center. Dark stripe on arm bordered by white stripes. White stripes do not continue onto disk.

Color oral surface: Dark stripe on arm, lighter and more grainy than stripe on aboral side. Oral and adoral shields also dark striped.

Distribution: Anguilla, Antigua, Bahamas, Barbados, Barbuda, Belize, Bermuda, Bonaire, Brazil, Cuba, Curaçao, Dominica, Dominican Republic, Dry Tortugas, Florida, Grenada, Guadeloupe, Haiti, Jamaica, Martinique, Montserrat, Nevis, Panama, Puerto Rico, St. Barthelemy, St. Croix, St. John, St. Martin, St. Thomas, St. Vincent, Texas. Bathymetric range - to 200 m.

Discussion: A striking brittlestar normally found inside sponges or attached to gorgonians. It was collected from Stetson Bank.

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GLOSSARY

(Figures 48-50)

ABORAL - The side opposite the mouth.

ABORAL ARM PLATE - The plate of an arm segment of an ophiuroid covering the aboral surface.

ADAMBULACRAL PLATE - The plate that borders the groove in asteroids, lateral to the ambulacral plate.

ADAPICAL SUTURE - The suture joining the plates on an echinoid test that is located at the aboral side of the plate.

ADORAL SHIELD - Two small plates on the oral side of an ophiuroid adjoining the oral shield.

ADORAL SUTURE - The suture joining the plates on an echinoid test that is located at the oral side of the plate.

ADRADIAL SUTURE - The suture separating the column of ambulacral plates from the interambulacral plates.

AMBITUS - The widest diameter of an echinoid test.

AMBULACRAL PLATE - The plate inside the groove of an asteroid that has a passage way for the podia.

AMBULACRUM - The area containing the podia. In asteroids, the ambulacral areas are in grooves on the oral side of the arms. In ophiuroids, they are on the oral side of the arms not in grooves. The test of echinoids has five areas each composed of two columns of plates. In holothuroids, the areas or radii may or may not be obvious externally.

AMPULLA - An internal sac-like extension of the tentacles on holothuroids or the podia in asteroids used in water movement for the water vascular system.

APICAL SYSTEM - The ring of ten plates, five ocular and five genital, surrounding the aboral pole of an echinoid.

ARISTOTLE'S LANTERN - The chewing apparatus of an echinoid made of five pyramids.

BUCCAL - Referring to the mouth area of an echinoid, which is usually covered with a

membrane that is invested plates.

CALCAREOUS RING - A ring of ten pieces, five radials and five interradials, that is located internally near the anterior end of a holothuroid. It is the attachment sight of the tentacles, muscles and ring canal of the water vascular system.

CLAVULAE - Small, ciliated spines that occur in fasciole areas.

CRENULATE - Having ribbing on the platform of a tubercle of an echinoid.

DORSAL - The side normally away from the substrate. Due to the elongation of the oral-aboral axis in holothuroids and some echinoids the "top" is not always the aboral pole.

END PLATE - A large ossicle at the end of each podia in some holothuroids.

FASCIOLE - A narrow band of minute tubercles for the attachment of small, ciliated spines.

GENITAL PLATE - Five plates in the apical system of an echinoid each with a pore leading to the gonads.

GILL SLITS - Notches in the peristome border of an echinoid test.

INFEROMARGINAL PLATES - The plates in an asteroid at the oral-lateral edge of the arm.

INTERAMBULACRUM - Area not containing the podia.

INTERBRACHIAL - Area between the arm axis.

INTERRADIAL PIECE - One of five pieces of the calcareous ring with a single anterior projection and no posterior projections.

INTERRADIAL SUTURE - The suture separating the two columns of interambulacral plates from one another.

INTROVERT - The collar-like area to which the tentacles are attached in some holothuroids that can be introverted into the body.

JAW - Five triangular areas of the mouth frame of an ophiuroid or asteroid.

LABRUM - Enlarged lip-like area near peristome in a spatangoid echinoid.

LUNULE - An oval hole in the test of sand dollars.

MADREPORITE - The sieve-like opening to the water vascular system.

MAMELON - The rounded top of a tubercle that articulates with the spine.

MILLED RING - Disk-like ring at base of echinoid spine used for muscle attachment.

OCULAR PLATE - In echinoids: five plates in the apical system. In asteroids: the last plate at the aboral-distal tip of the arms.

ORAL - The side containing the mouth.

ORAL ARM PLATE - The plate an arm segment of an ophiuroid covering the oral surface.

ORAL SHIELD - The plate in ophiuroids located on the oral side in each interbrachial area at the distal end of the jaws.

OSSICLE - The individual skeletal elements made of calcium carbonate.

PAPILLAE - A small, short, rounded spine-like projection.

PAPULLAE - A shallow depression on the surface of an asteroid with pores for tissue extensions used in respiration.

PAXILLAE - A tower-like skeletal element in asteroids that projects from the aboral surface.

PERRADIAL SUTURE - The suture separating the two columns of ambulacral plates from one another.

PERFORATE - Having a hole in the mamelon of a tubercle of an echinoid.

PERIPROCT - Area containing the anus in an echinoid.

PERISTOME - Area containing the mouth in an echinoid, usually covered with a membrane (see buccal).

PETAL - Area on the aboral or dorsal side of a clypeasteroid or spatangoid that has a concentration of respiratory podia.

PLASTRON - The enlarged ventral base of a spatangoid echinoid located posterior to the

peristome and made of the last plates in interambulacrum 5.

PODIA - Tube foot. The end of the water vascular system used in locomotion and respiration.

PODIAL SCALE - The plate(s) covering the opening for the podia in ophiuroids.

PORE PAIR - The two small openings in the test of an echinoid for each podia.

PYRAMID - One of five main pieces making up the Aristotle's lantern.

r - The radius of just the disk.

R - The radius as measured from the center of the disk to the tip of an arm.

RADIAL PIECE - One of five pieces of the calcareous ring of a holothuroid, which has an anterior projection that is usually bilobed at the end and may have posterior extensions.

RADII - The ambulacral areas visible on the external surface of a holothuroid.

SCROBICULAR - Referring to the sunken area surrounding the mamelon and platform of a tubercle used for spine muscle attachment. A ring of small tubercles surrounding a large tubercle.

SIDE ARM PLATE - The plate on each side of an arm segment of an ophiuroid that has arm spines attached to it.

SUPEROMARGINAL PLATES - The plates in an asteroid at the aboral-lateral edge of the arm.

TENTACLES - Modified podia at the anterior end of a holothuroid that surround the mouth and are used in feeding.

TUBERCLE - A raised attachment sight for the spines.

VENTRAL - The side normally in contact with the substrate upon which a specimen is found. Due to the elongation of the oral-aboral axis in holothuroids and some echinoids the "underside" is not always the oral pole.

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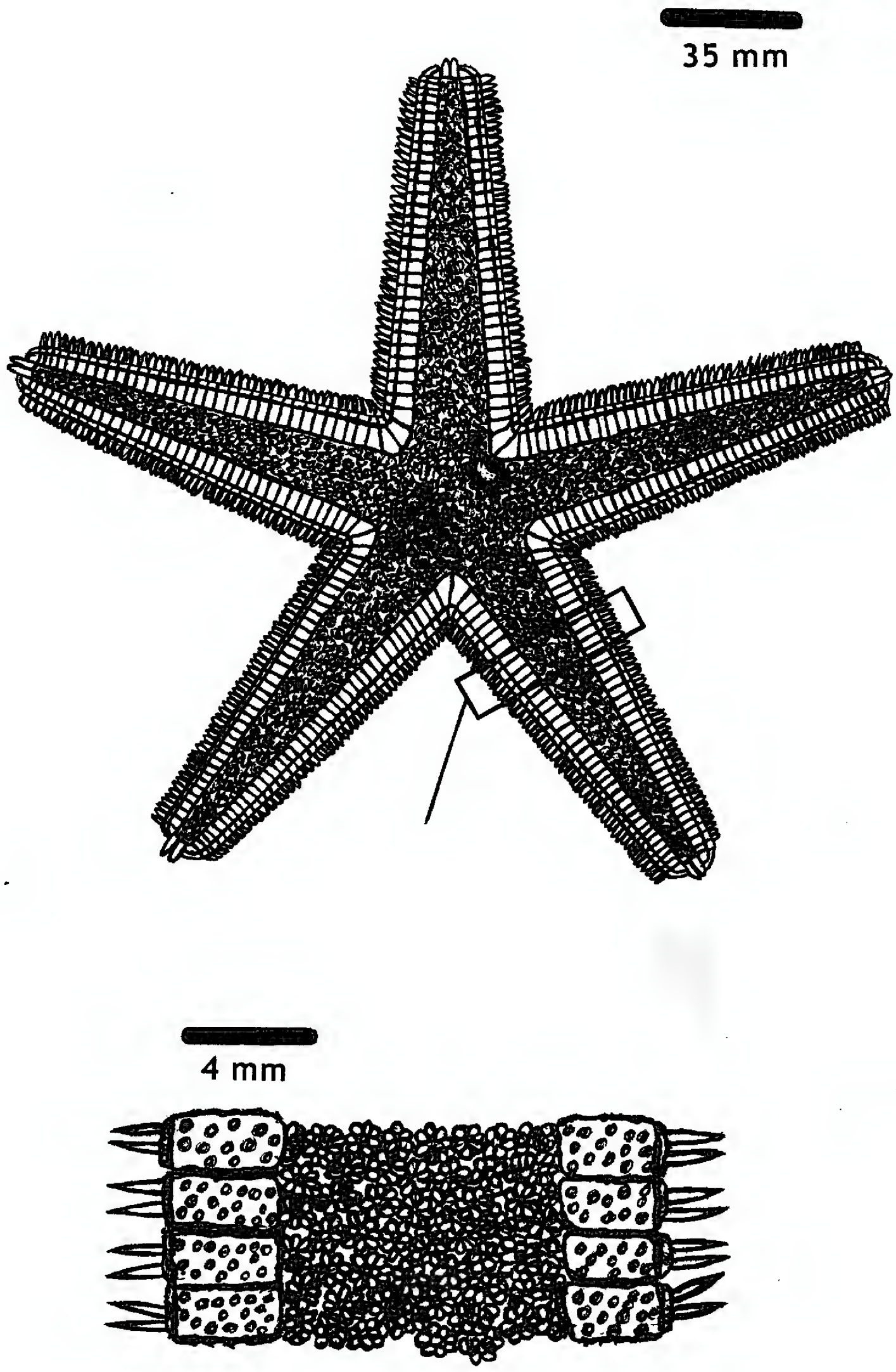


Figure 1. *Astropecten articulatus.*

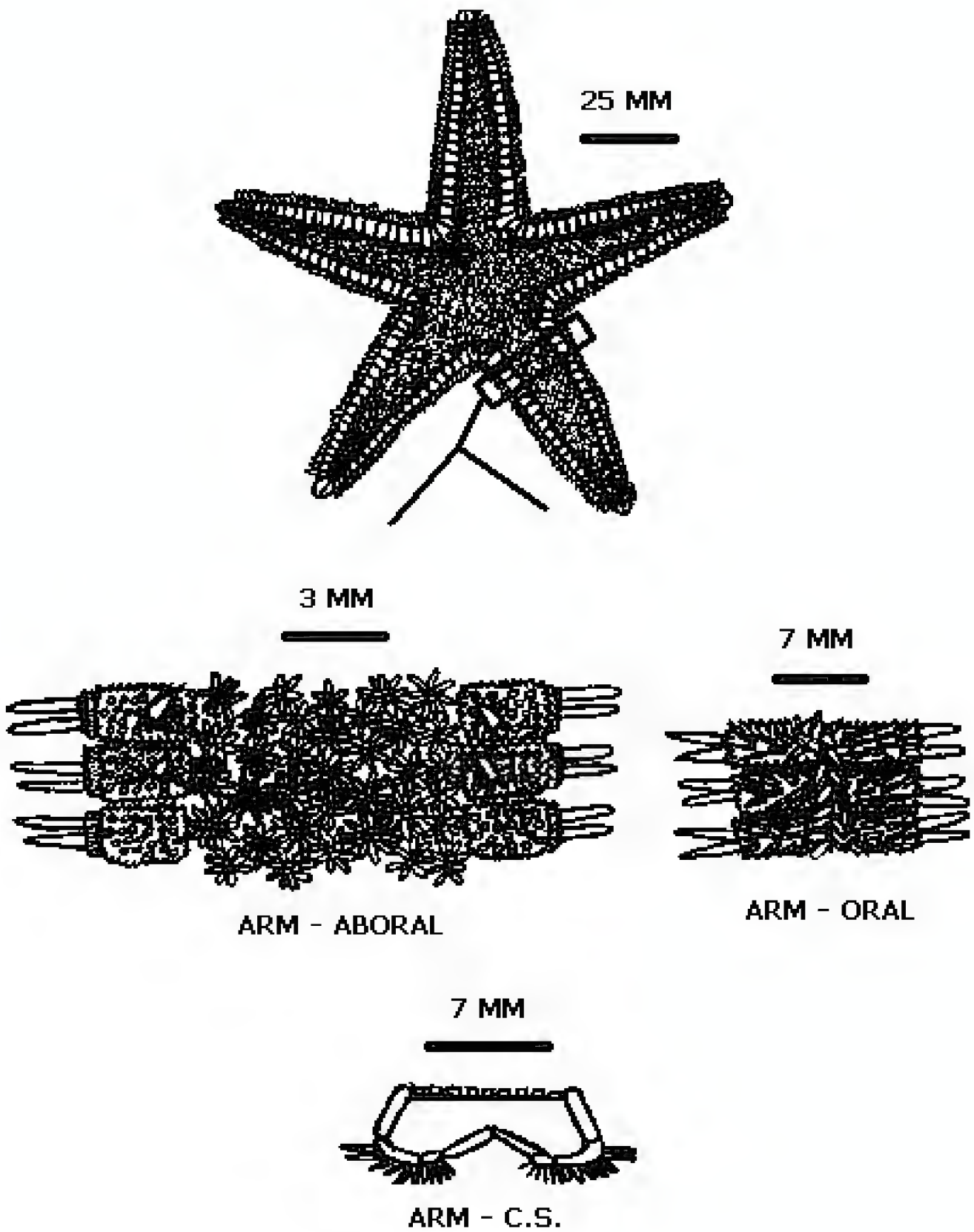


Figure 2. *Astropecten duplicatus.*

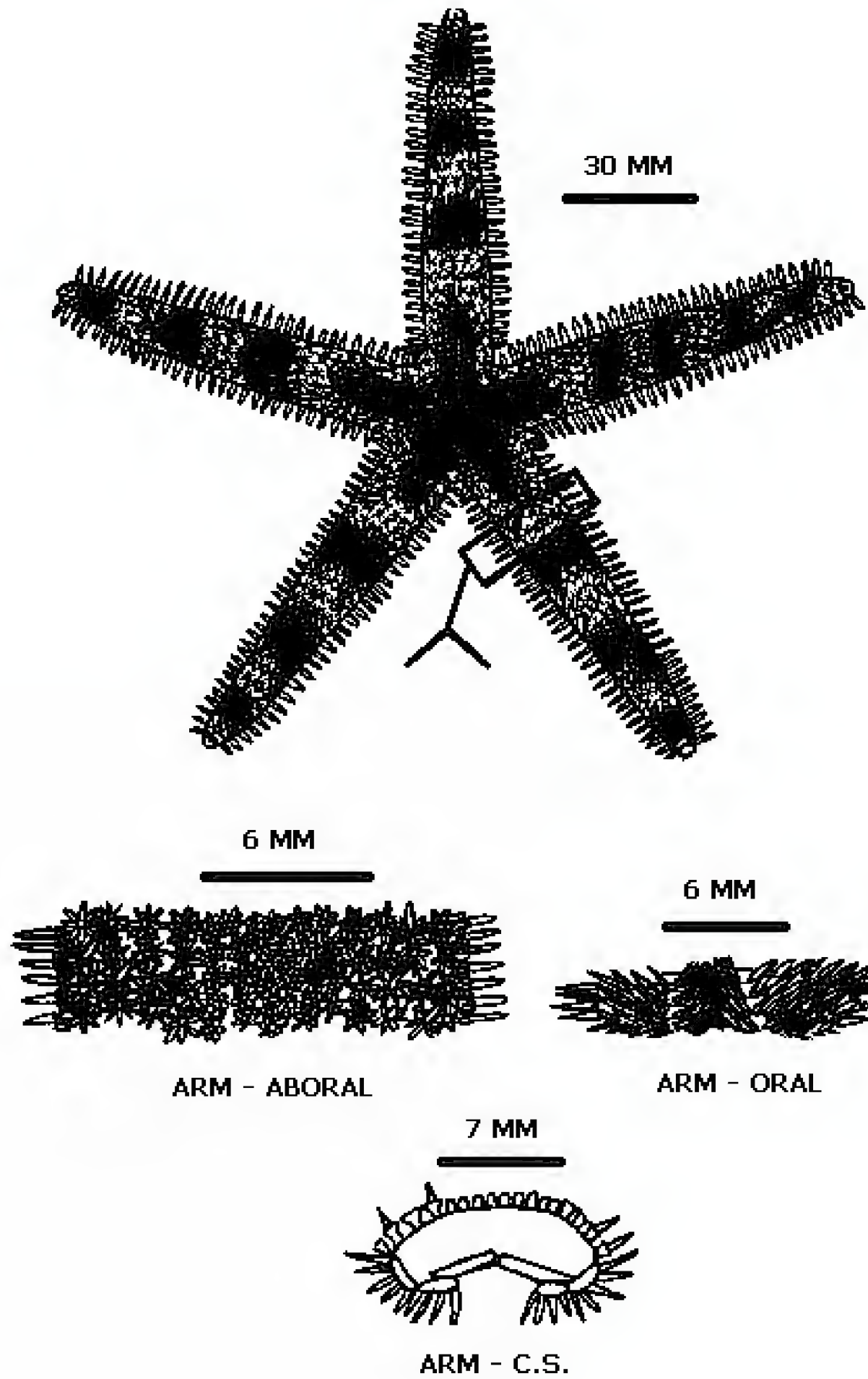
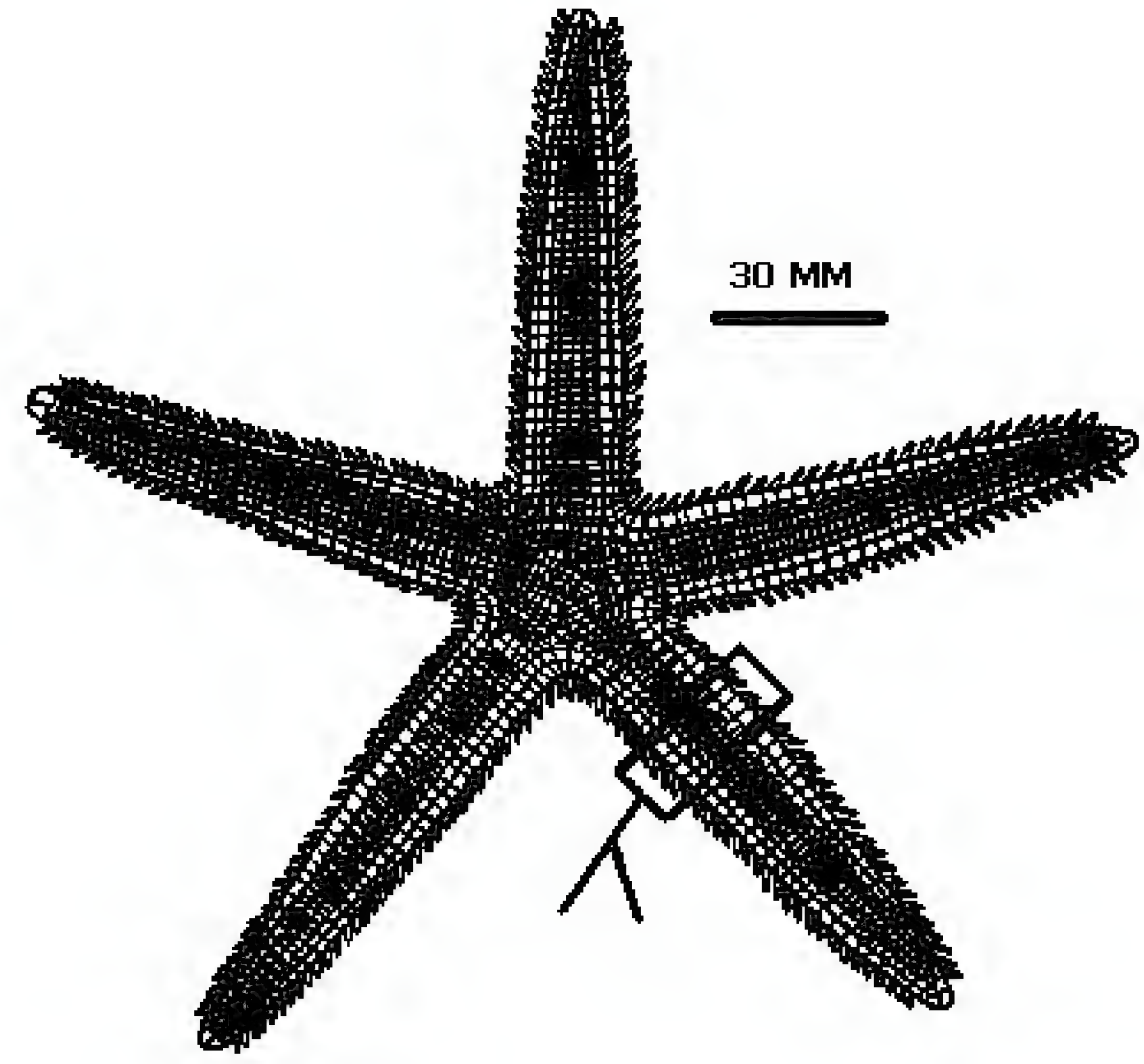
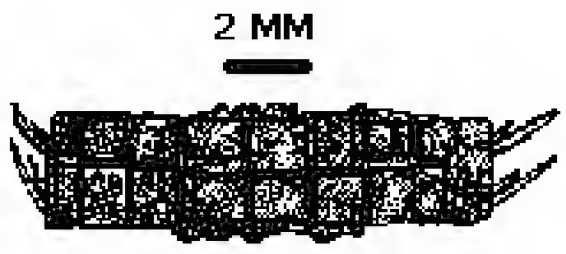


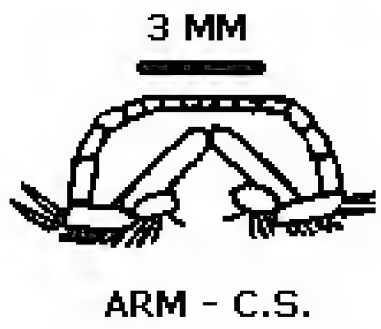
Figure 3. *Luidia alternata alternata.*





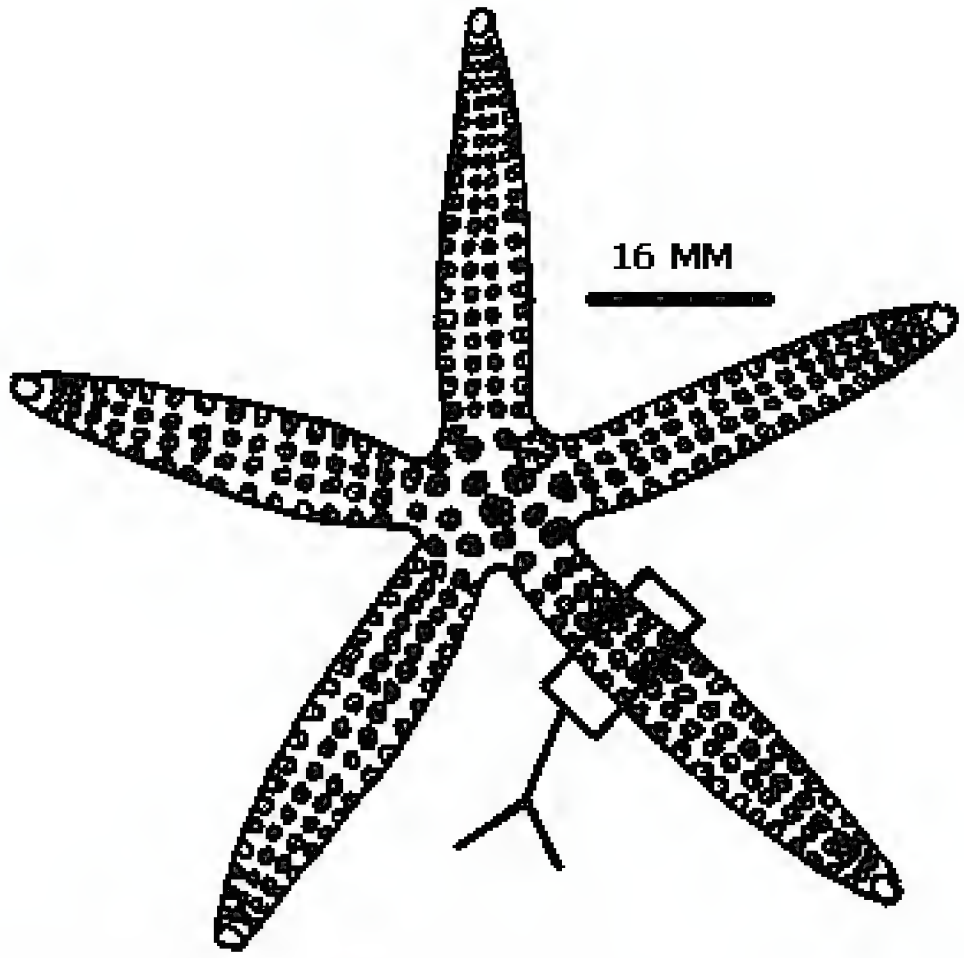
ARM - ABORAL

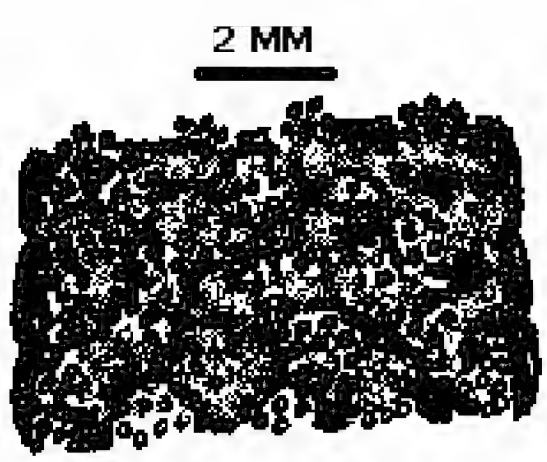
ARM - ORAL



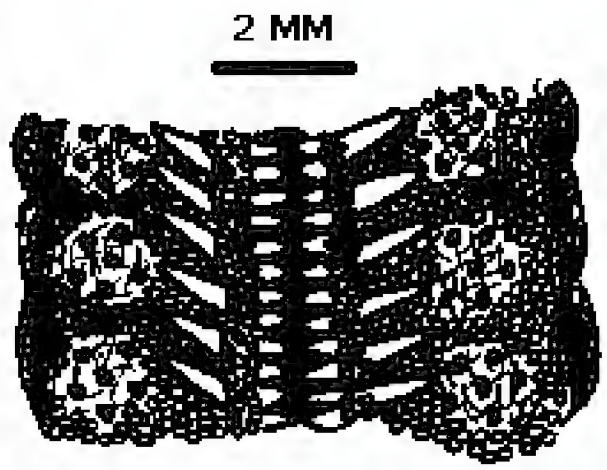
ARM - C.S.

Figure 4. *Luidia clathrata.*





ARM - ABORAL



ARM - ORAL

ARM - C.S.

Figure 5. *Ophidiaster guildingii.*

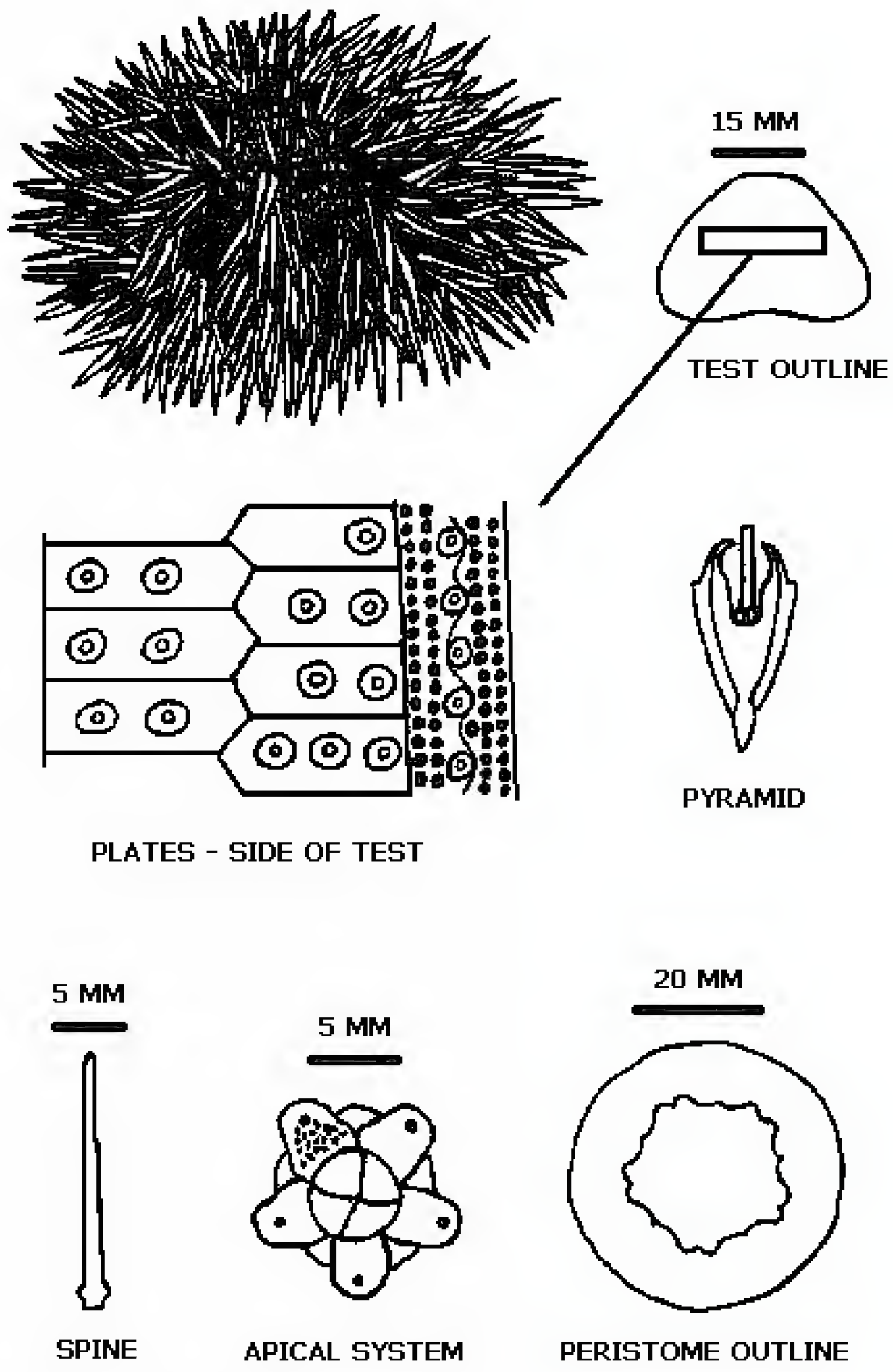
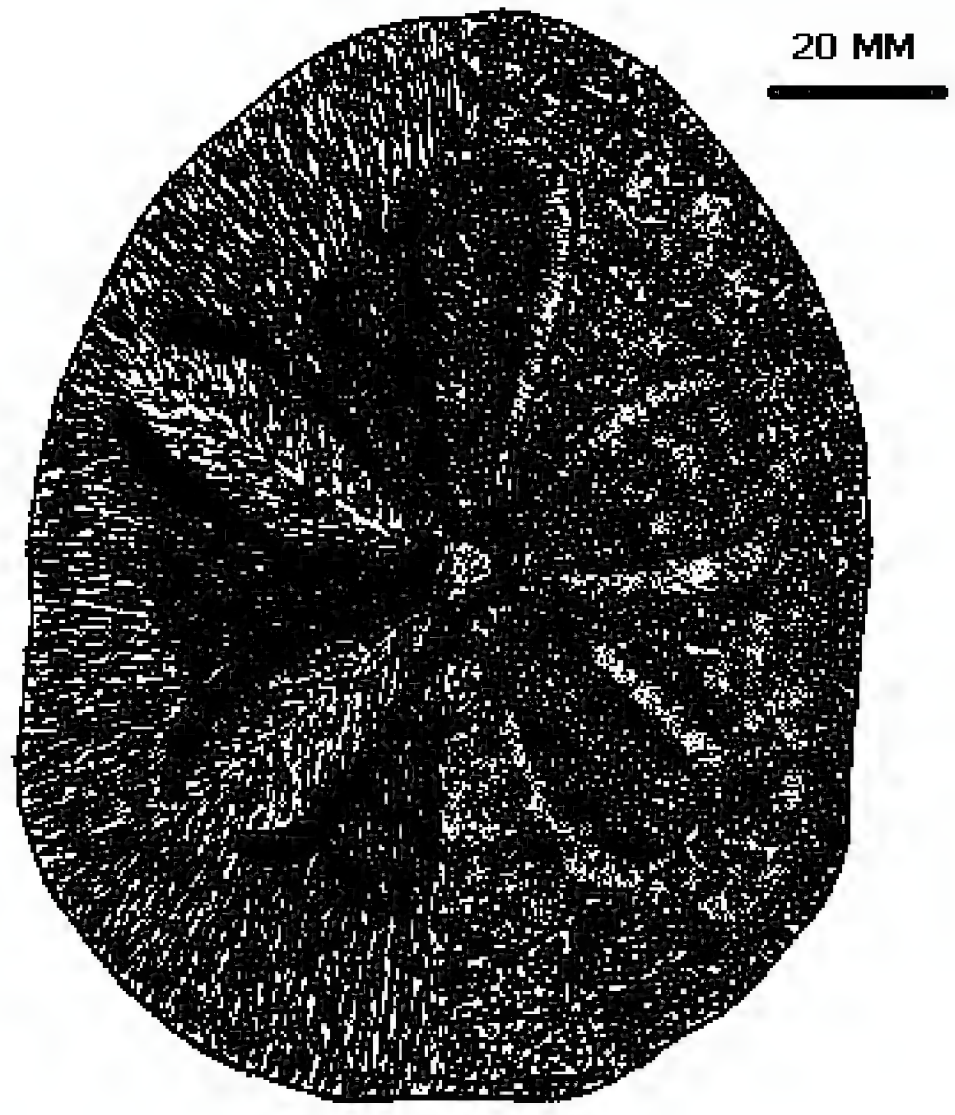
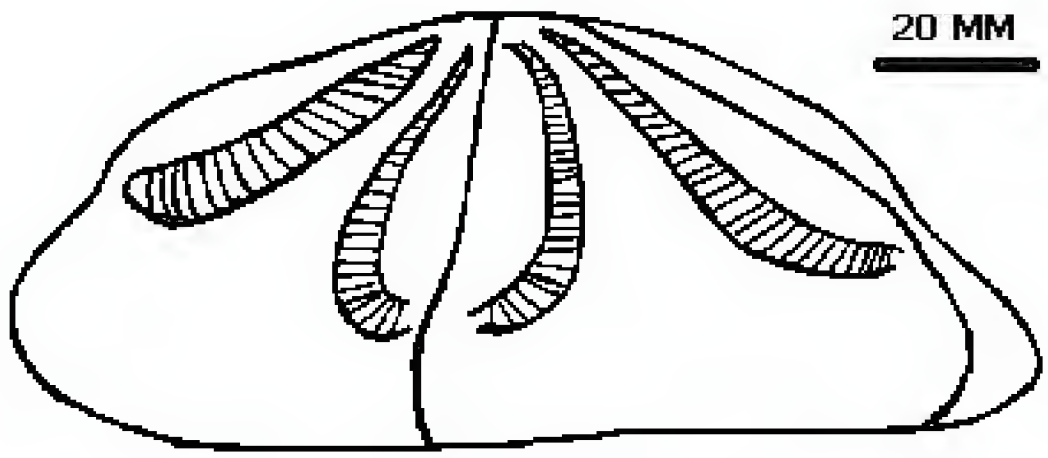


Figure 6. *Arbacia punctulata.*



TEST - ABORAL



TEST OUTLINE

Figure 7. *Clypeaster rosaceus.*

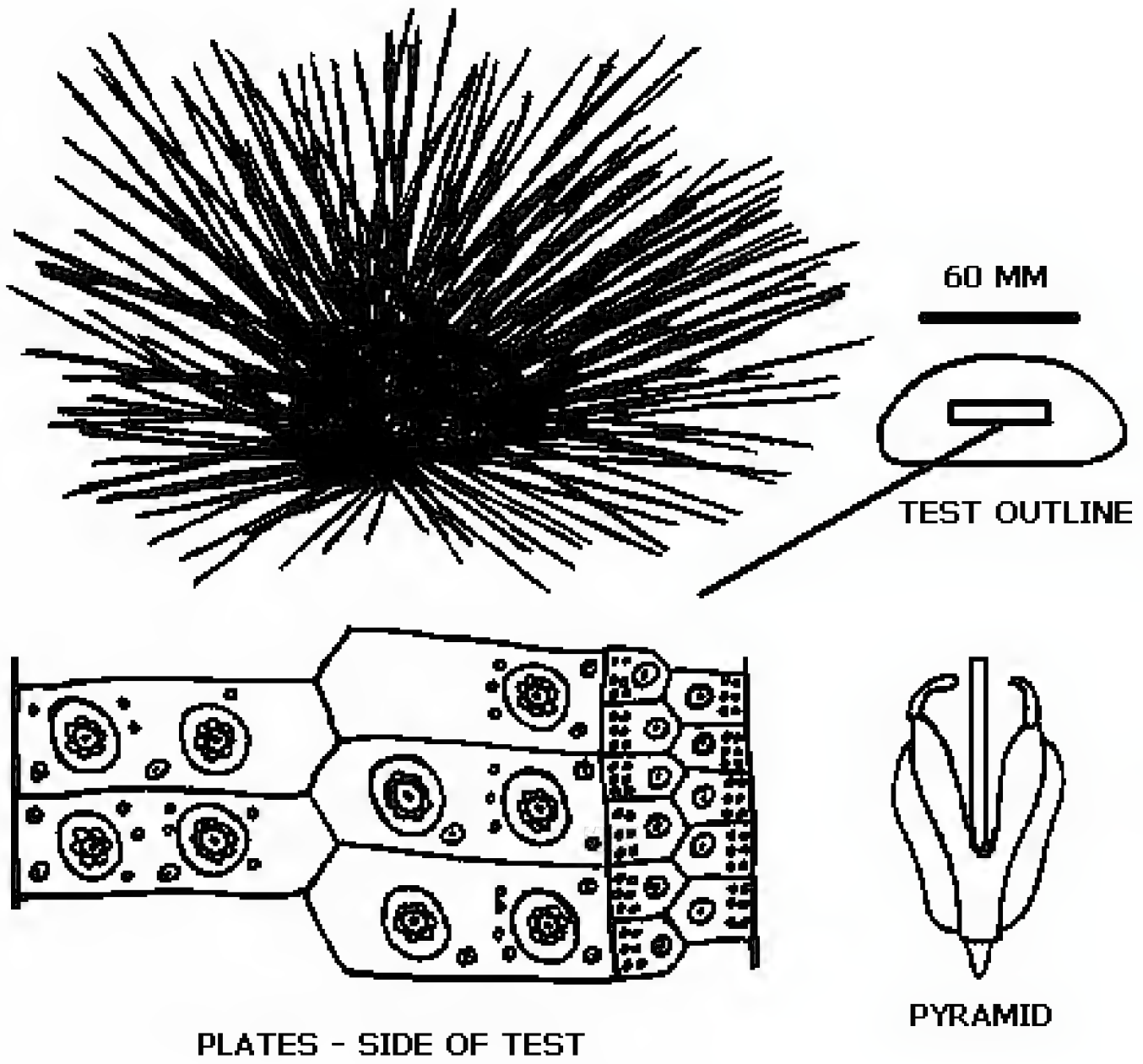
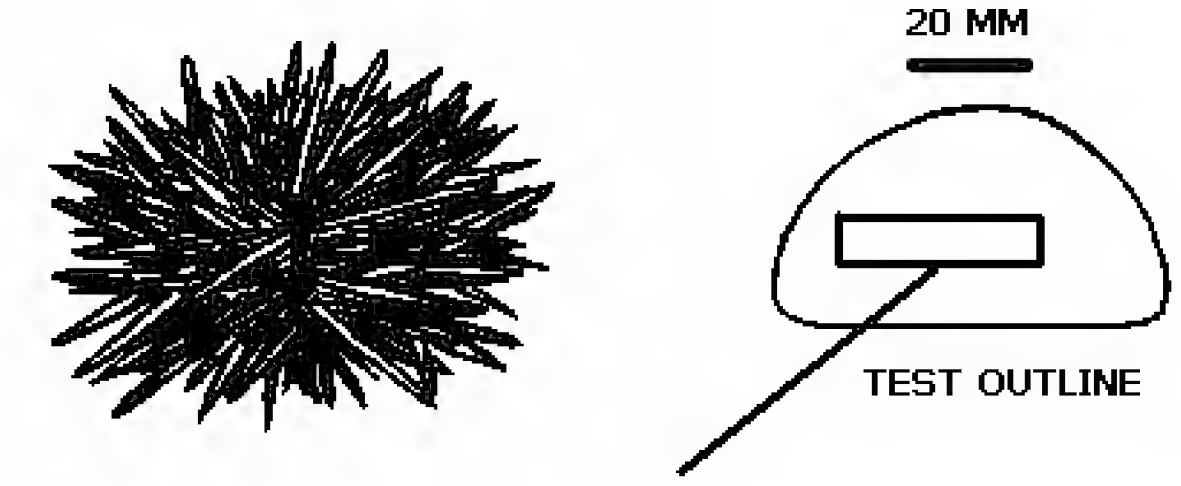
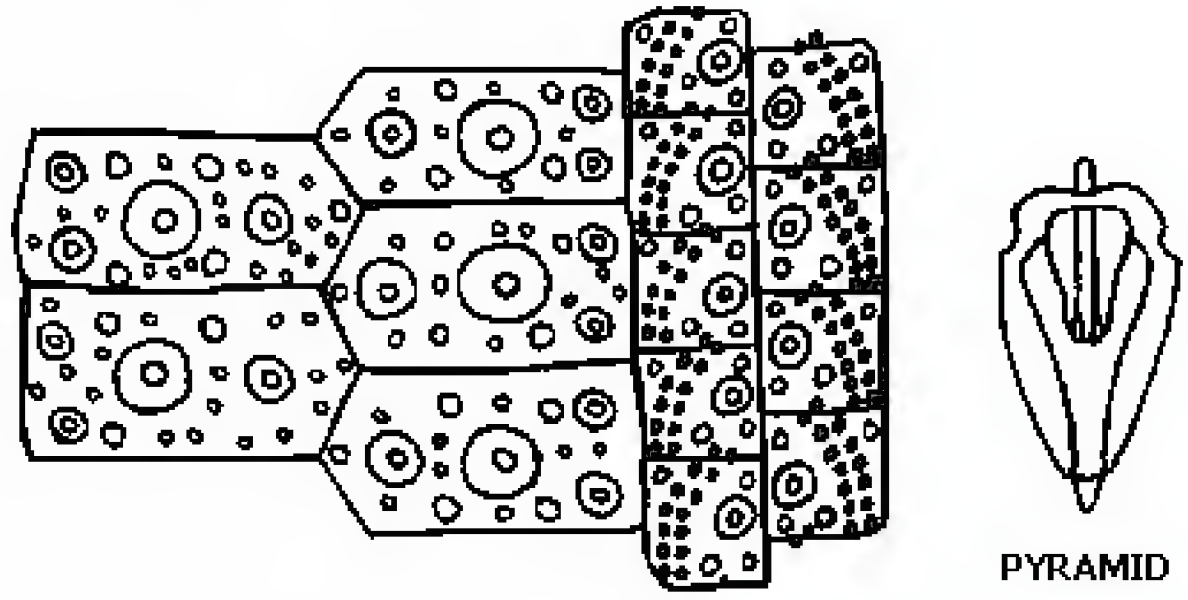


Figure 8. *Diadema antillarum.*





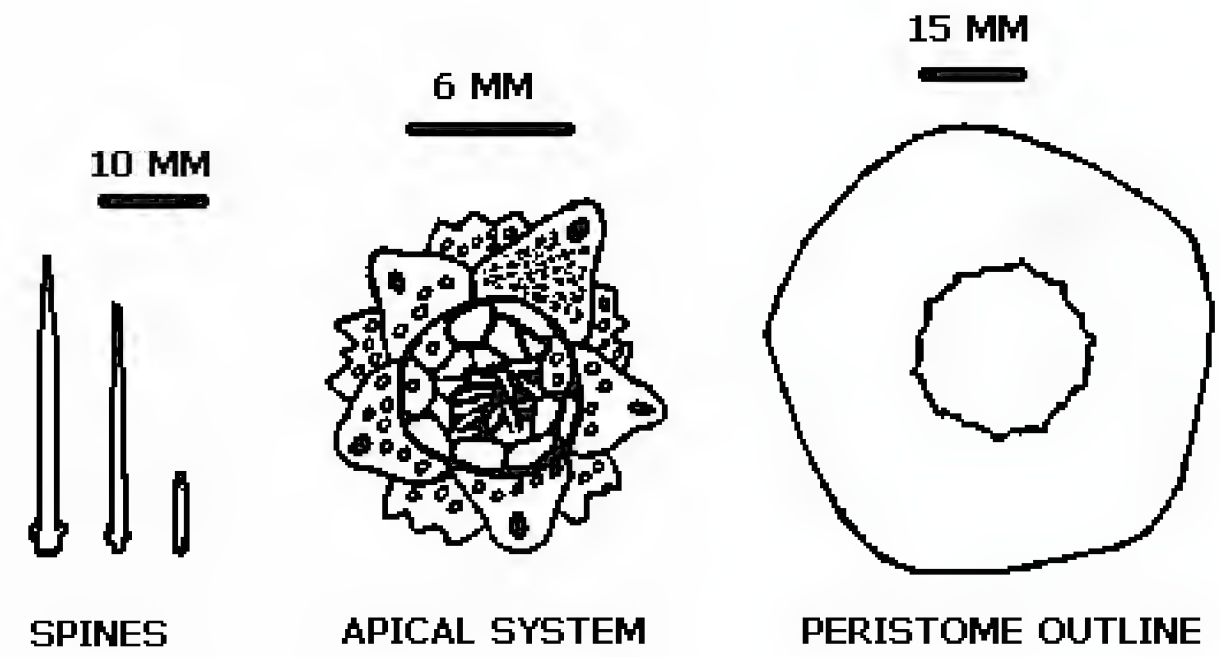


Figure 9. *Echinometra lucunter lucunter.*

Figure 10. *Encope michelini.*

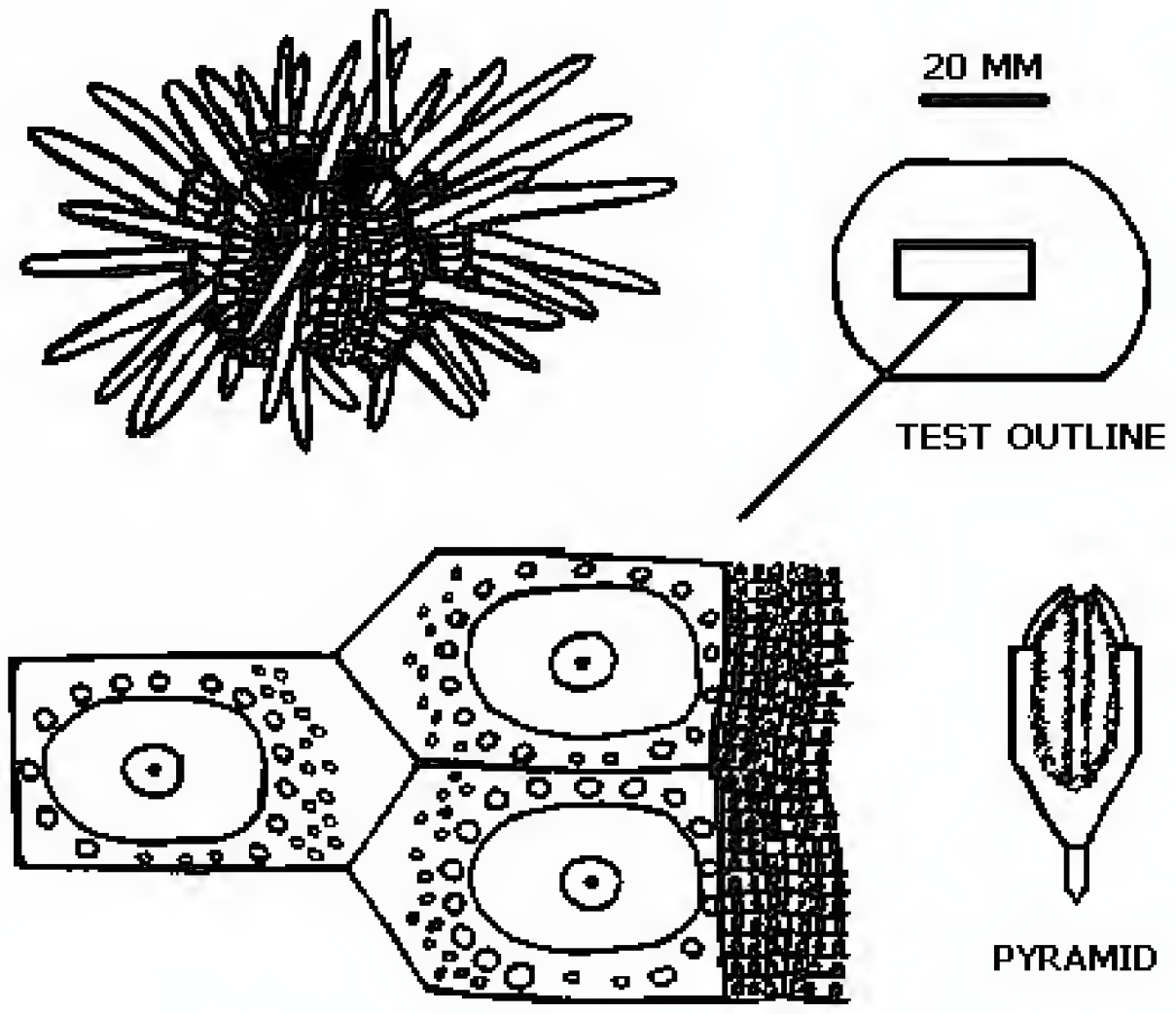
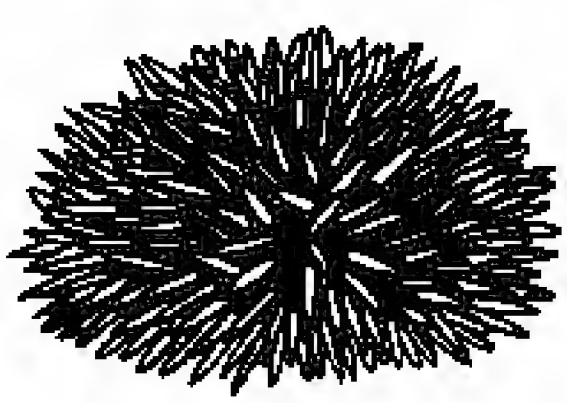
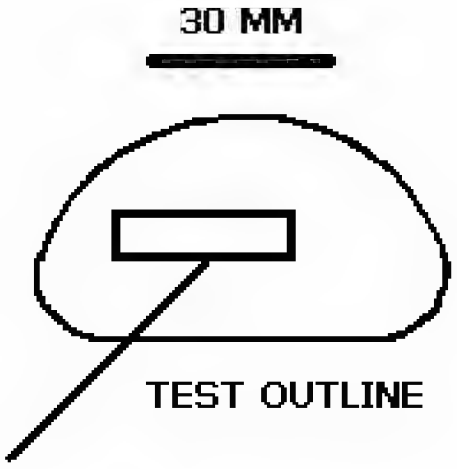
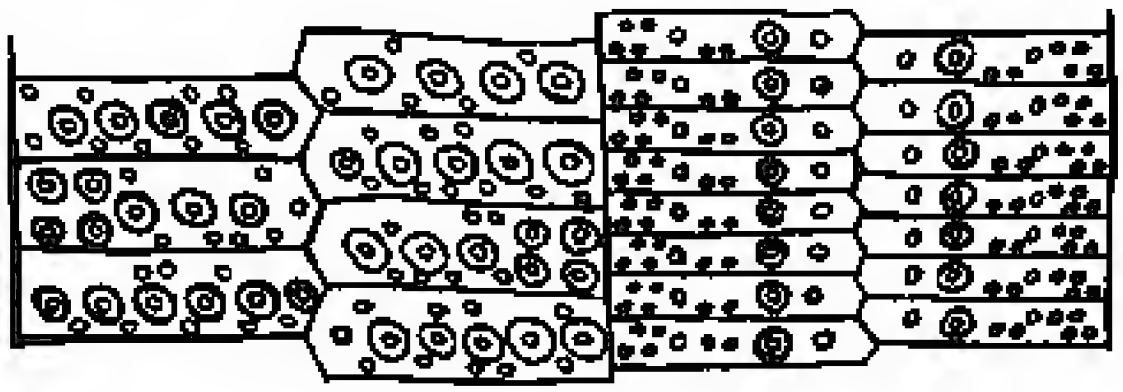


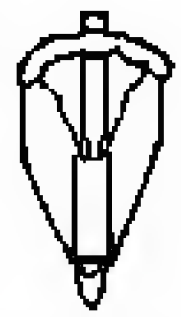
Figure 11. *Eucidaris tribuloides tribuloides.*





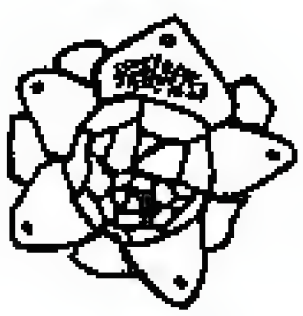


PLATES - SIDE OF TEST

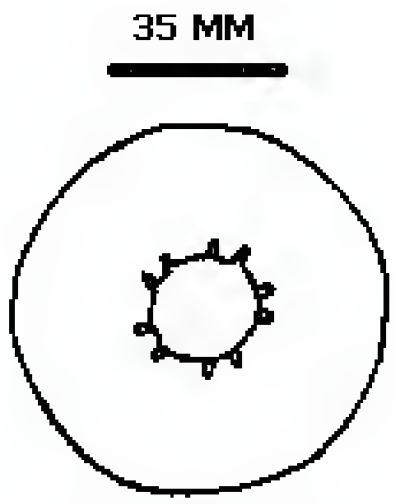


PYRAMID

SPINES



APICAL SYSTEM



PERISTOME OUTLINE

Figure 12. *Lytechinus variegatus.*

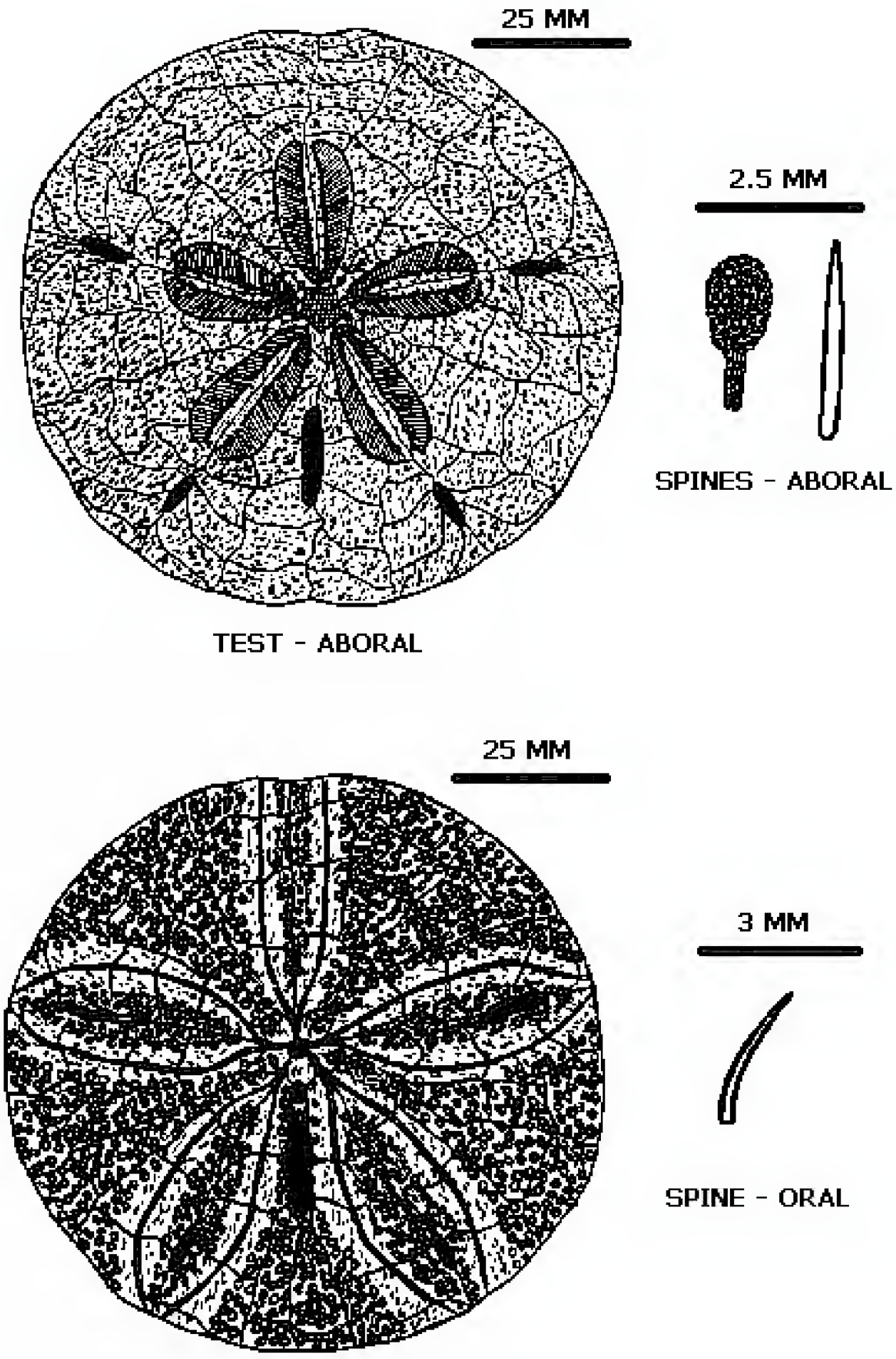


Figure 13. *Mellita quinquiesperforata.*

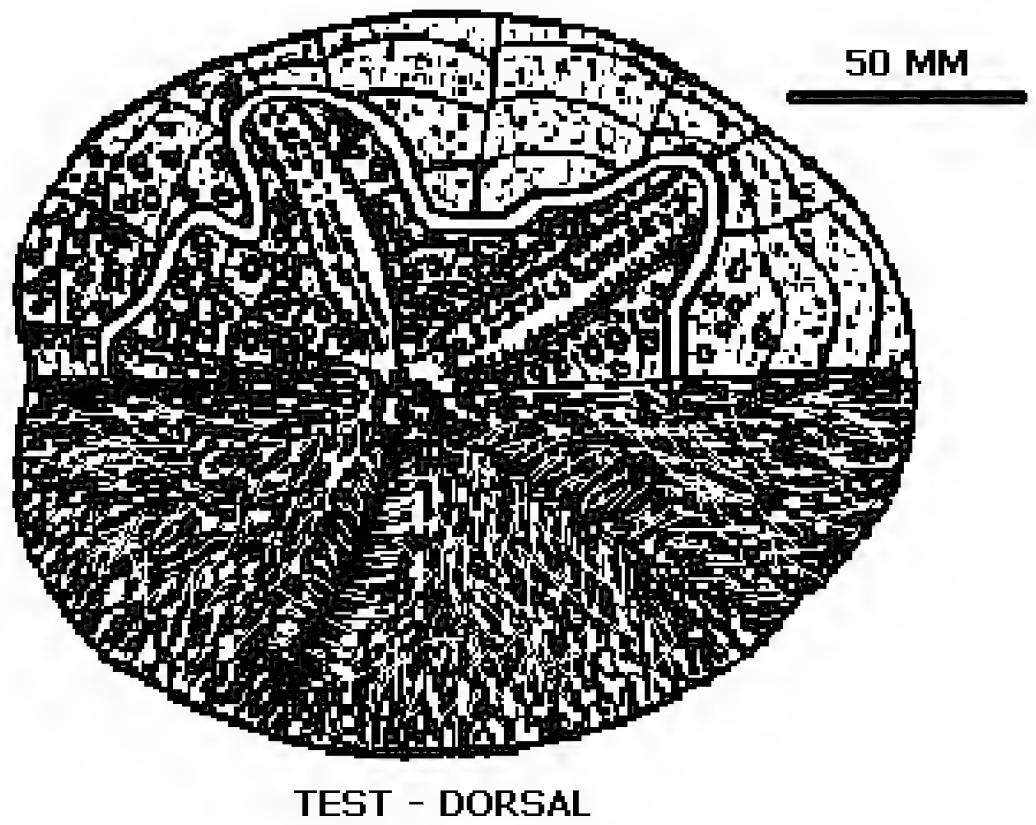


Figure 14. *Meoma ventricosa ventricosa.*

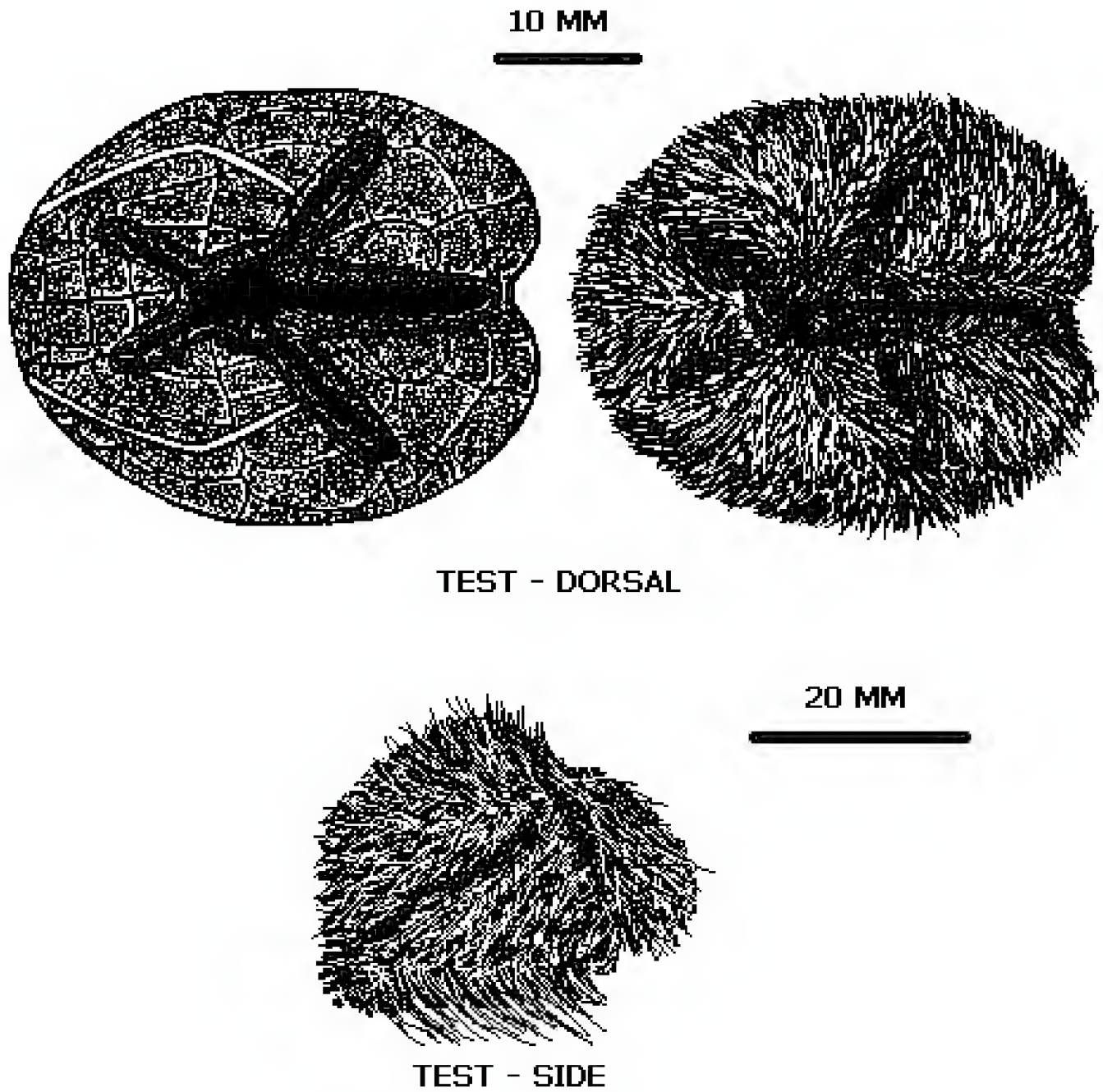
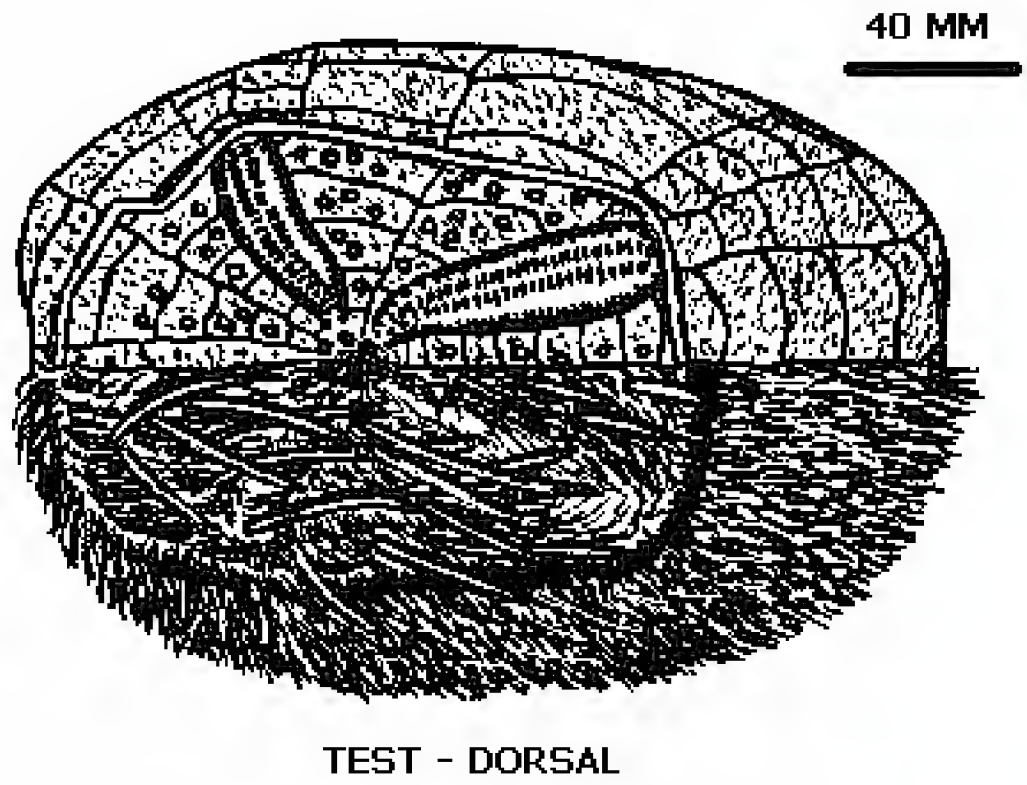


Figure 15. *Moira atropos.*



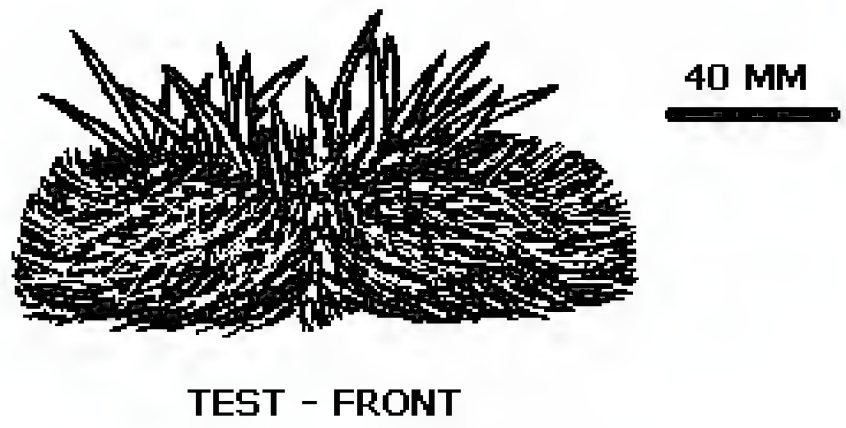


Figure 16. *Plagiobrissus grandis.*

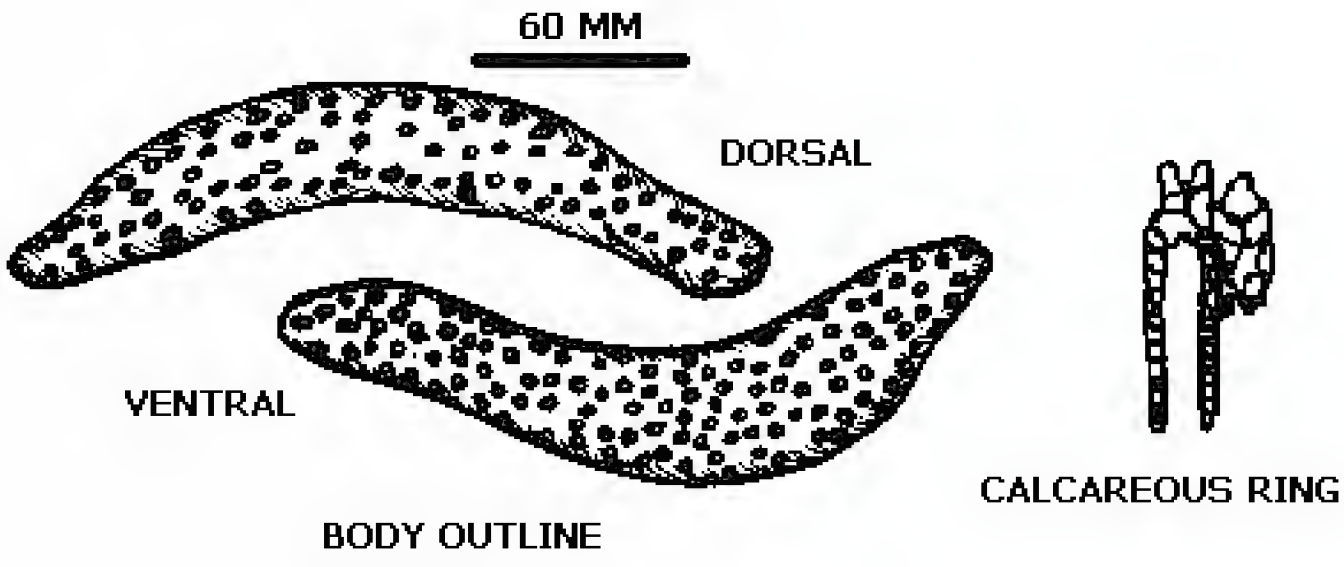


Figure 17. *Allothyone mexicana.*

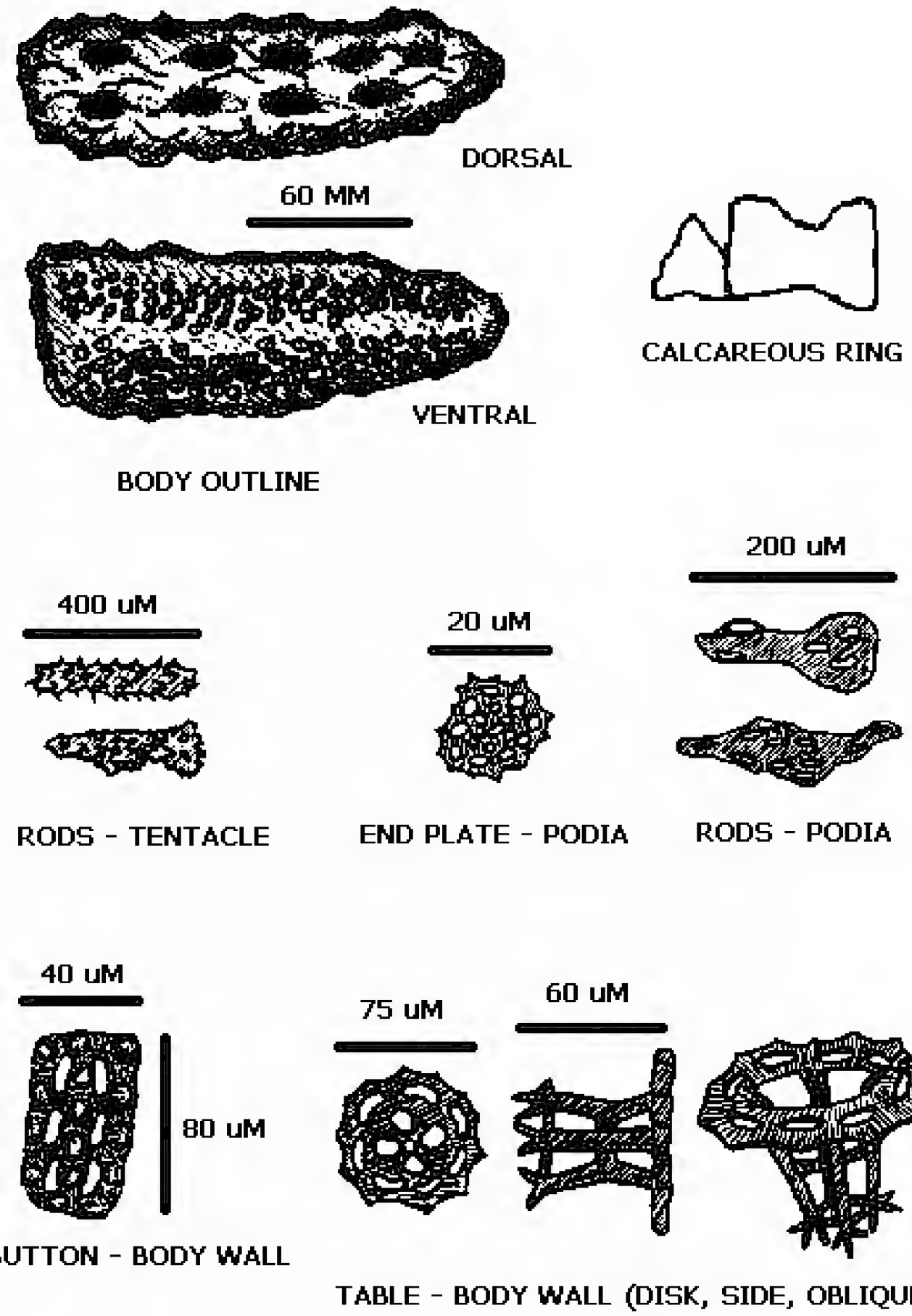


Figure 18. *Holothuria (Holothuria) dakarensis.*

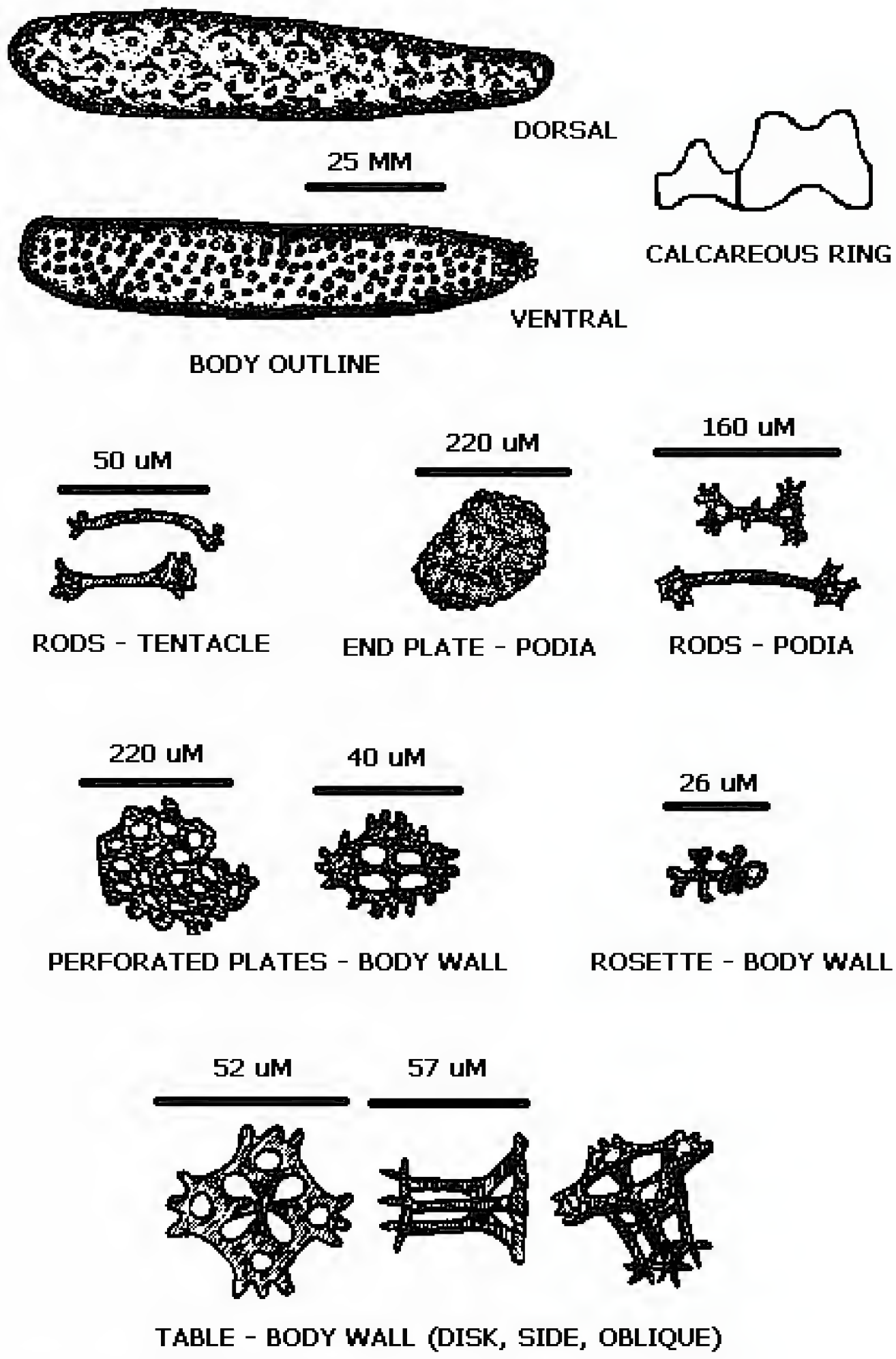


Figure 19. *Holothuria (Halodeima) grisea.*

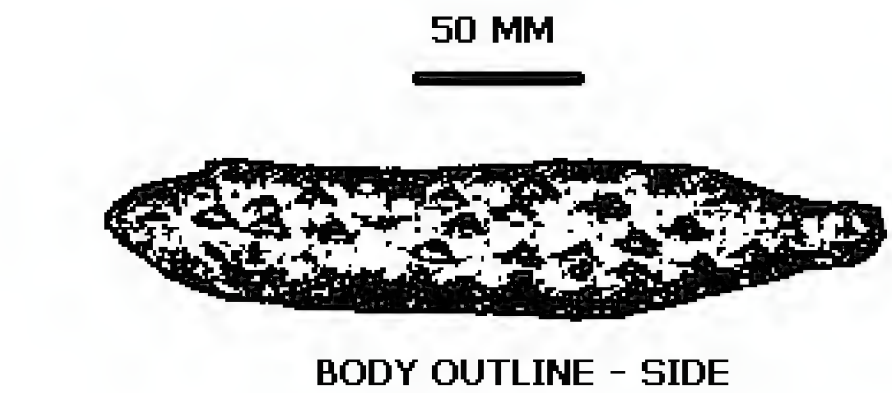


Figure 20. *Holothuria (Semperothuria) surinamensis.*

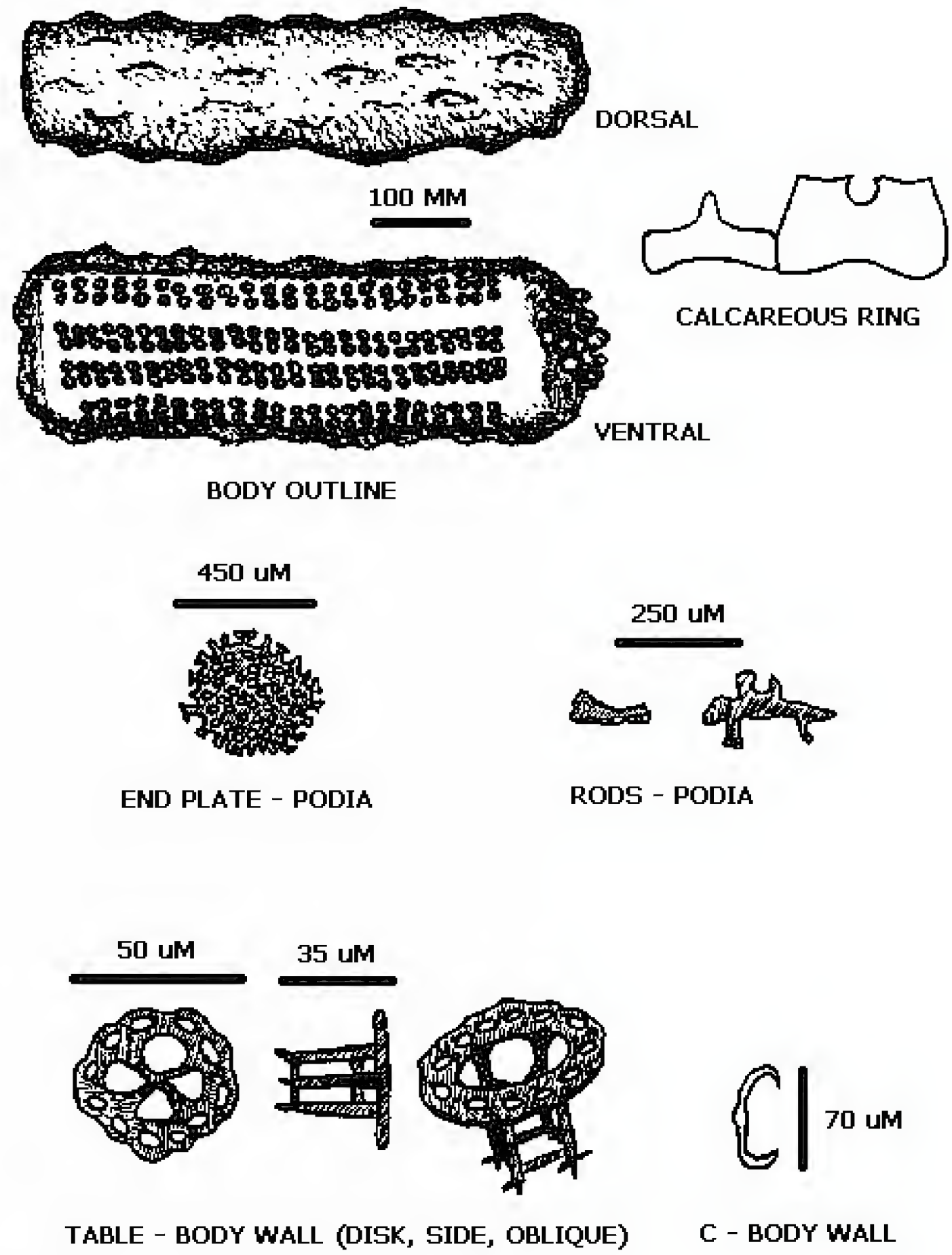
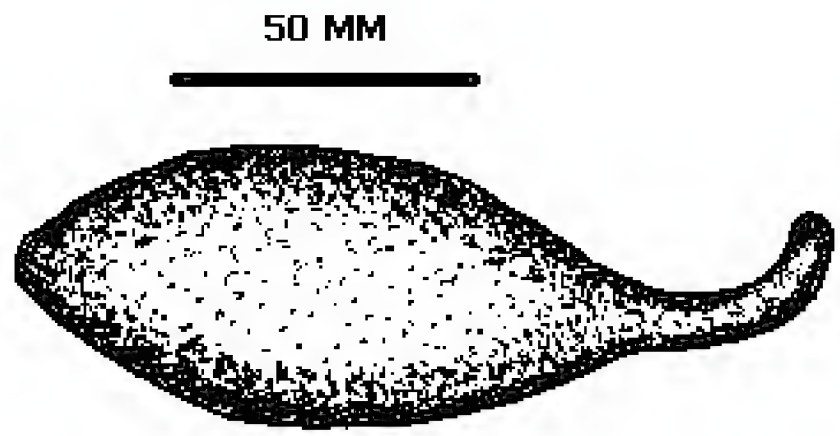
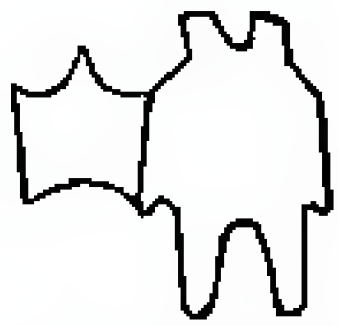


Figure 21. *Isostichopus badionotus.*





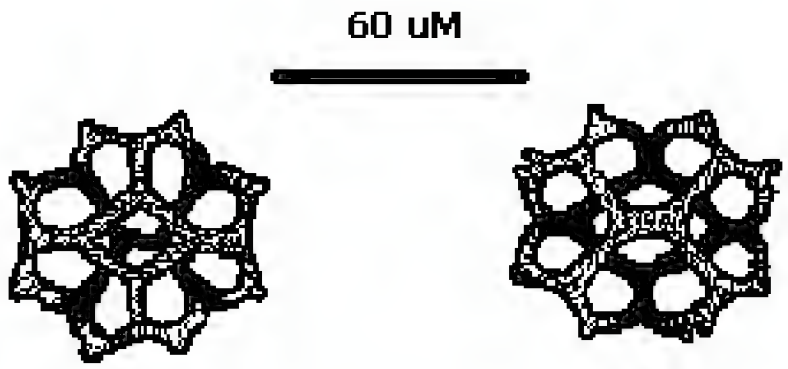
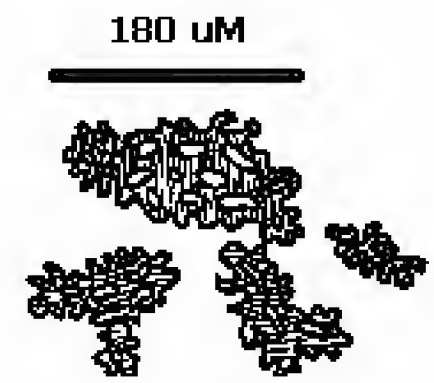


Figure 22. *Paracaudina chilensis obesacauda.*

BODY OUTLINE - SIDE

CALCAREOUS RING



PERFORATED PLATES - TENTACLE

END PLATE - PODIA

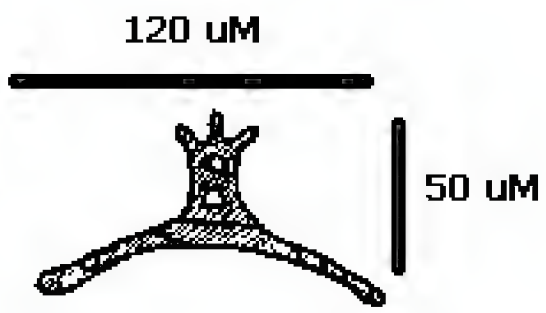


TABLE - PODIA

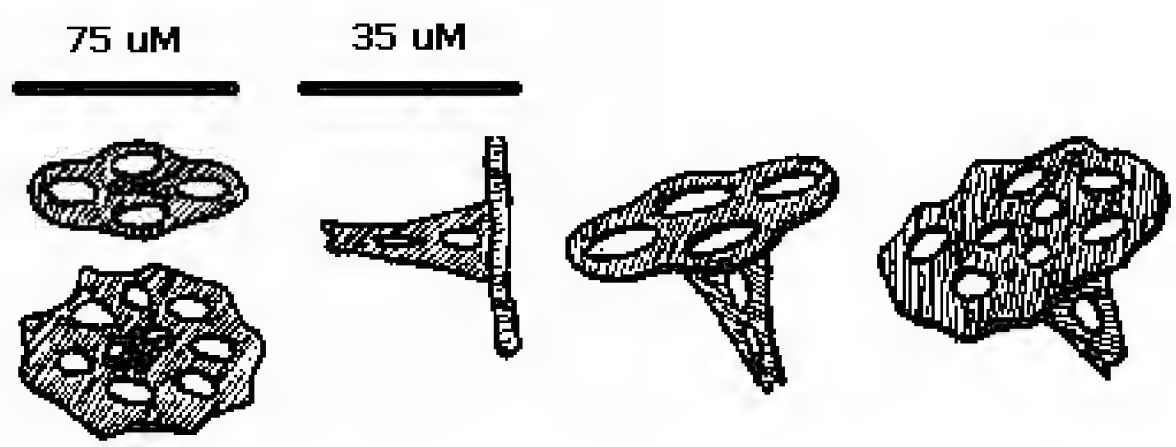


TABLE - BODY WALL (DISK, SIDE, OBLIQUE)

Figure 23. *Pentamera pulcherrima.*

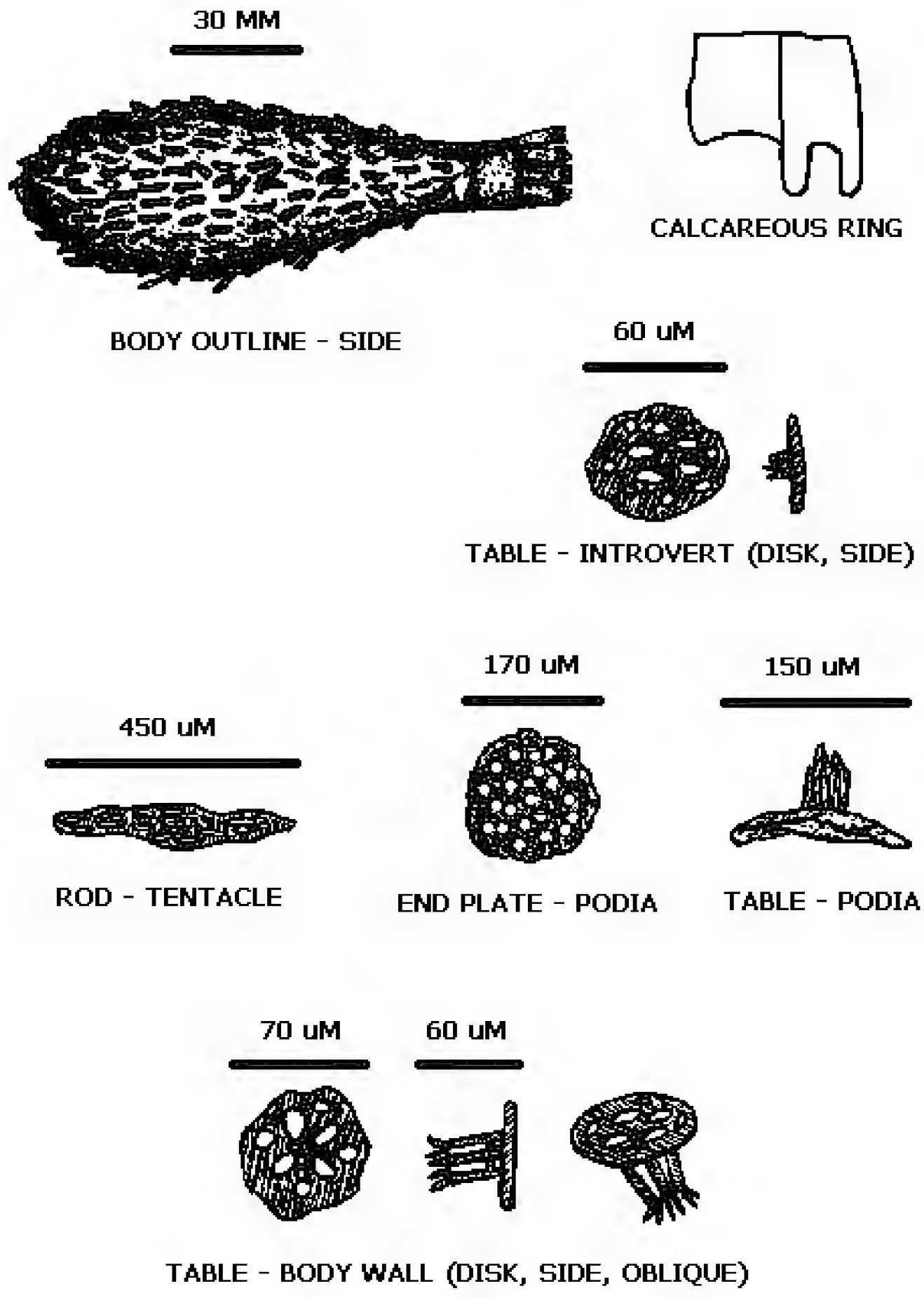


Figure 24. *Sclerodactyla briareus.*

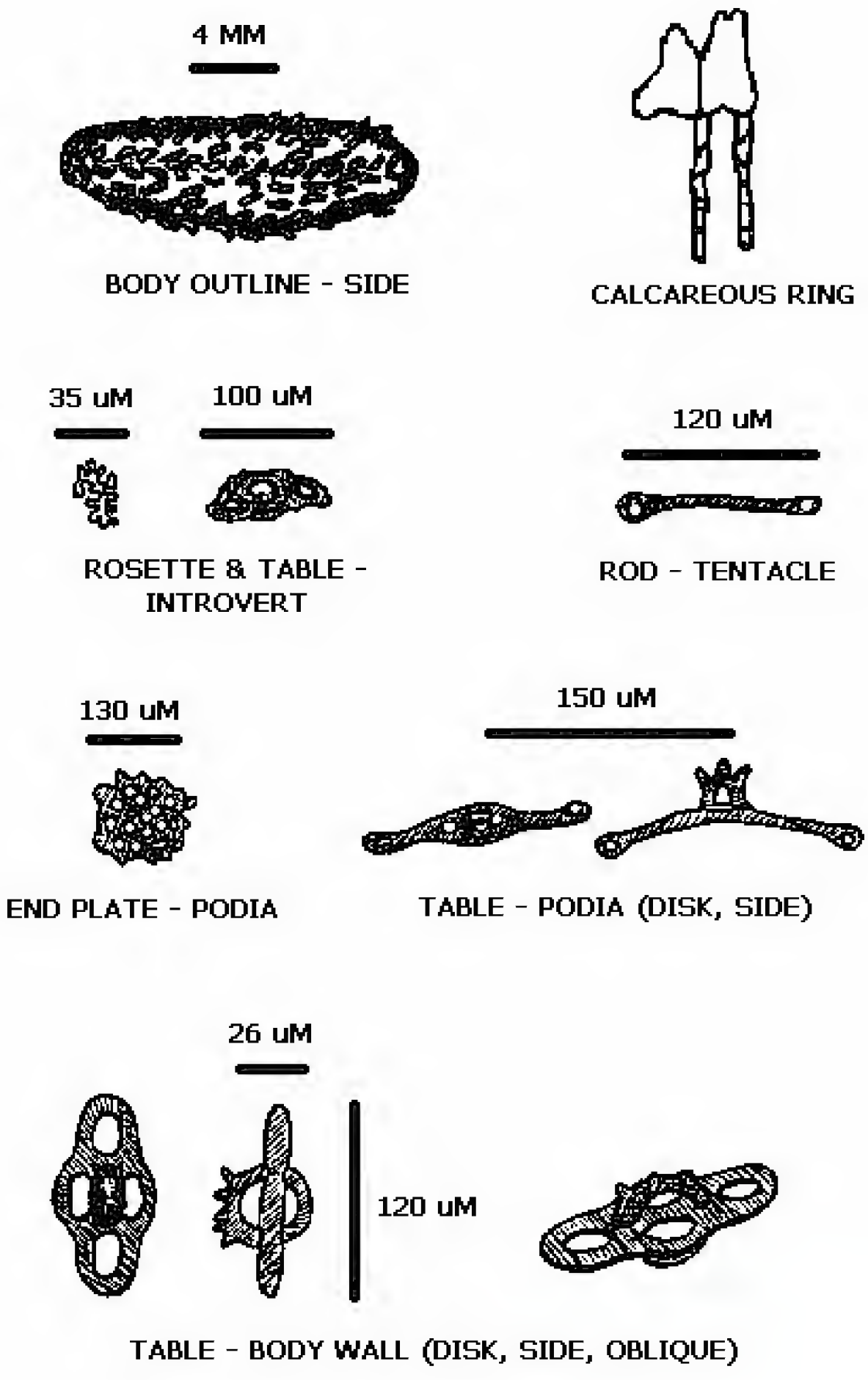


Figure 25. *Thyone pseudofusus.*

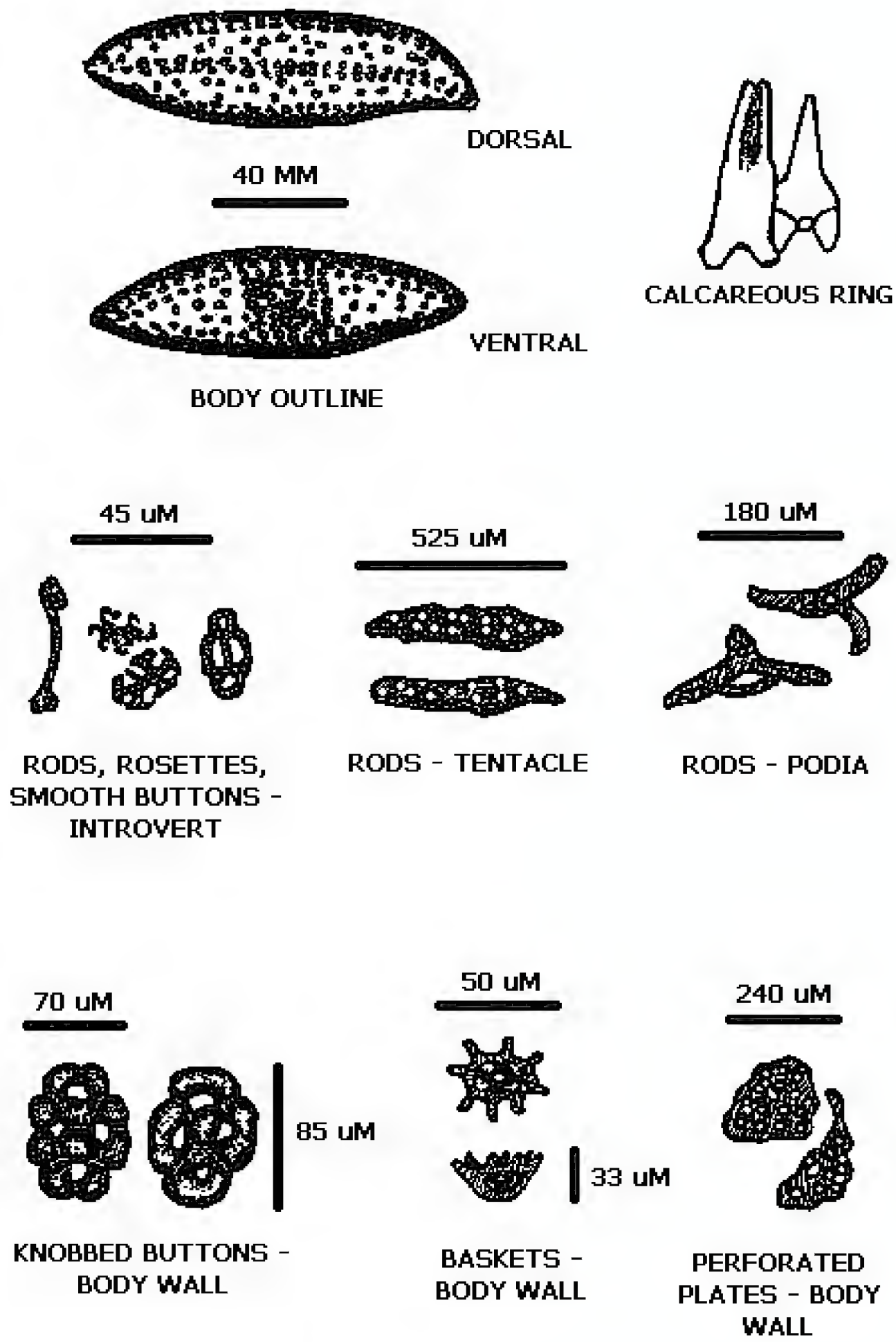


Figure 26. *Thyonella gemmata.*

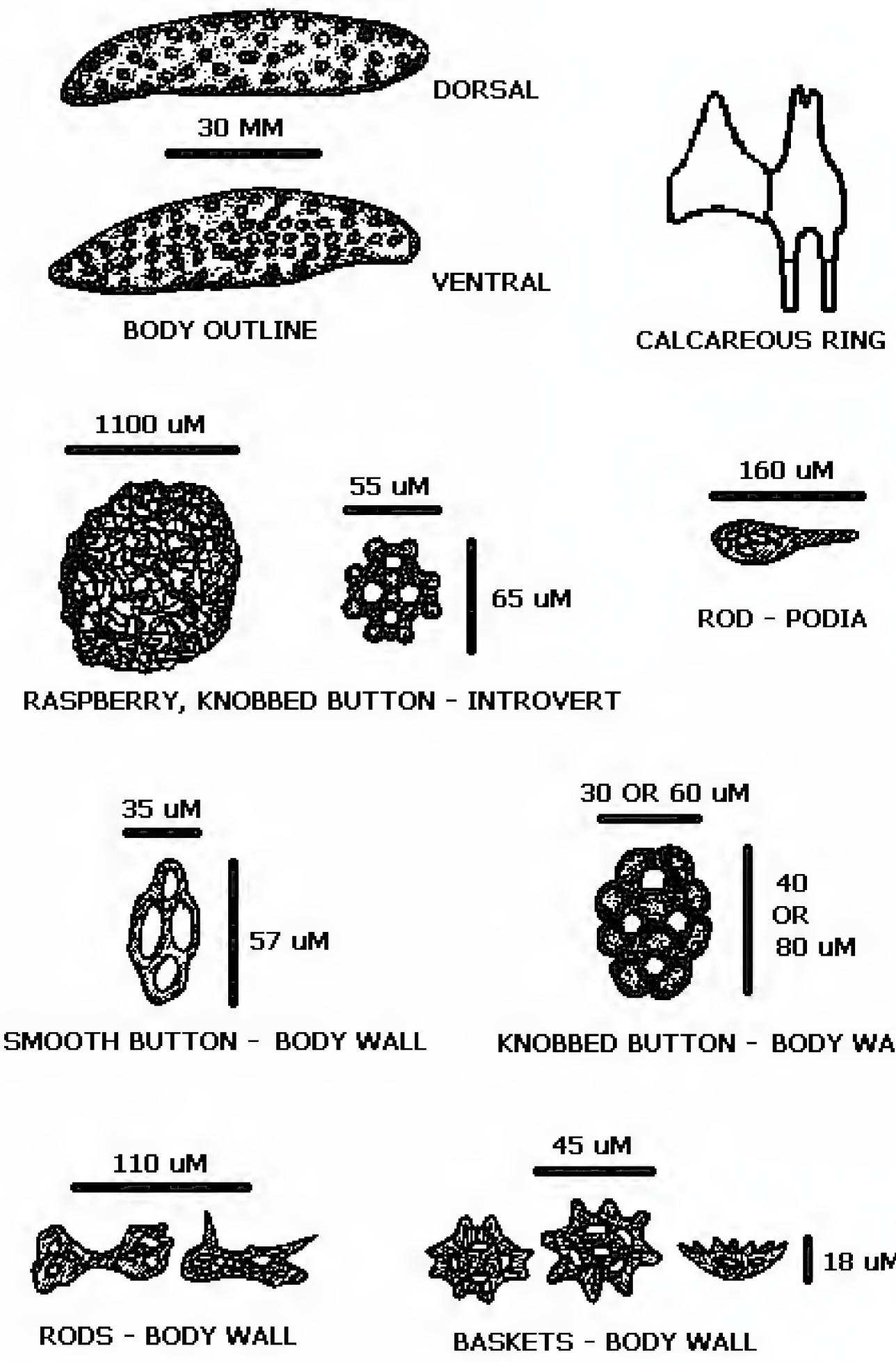


Figure 27. *Thyonella pervicax.*

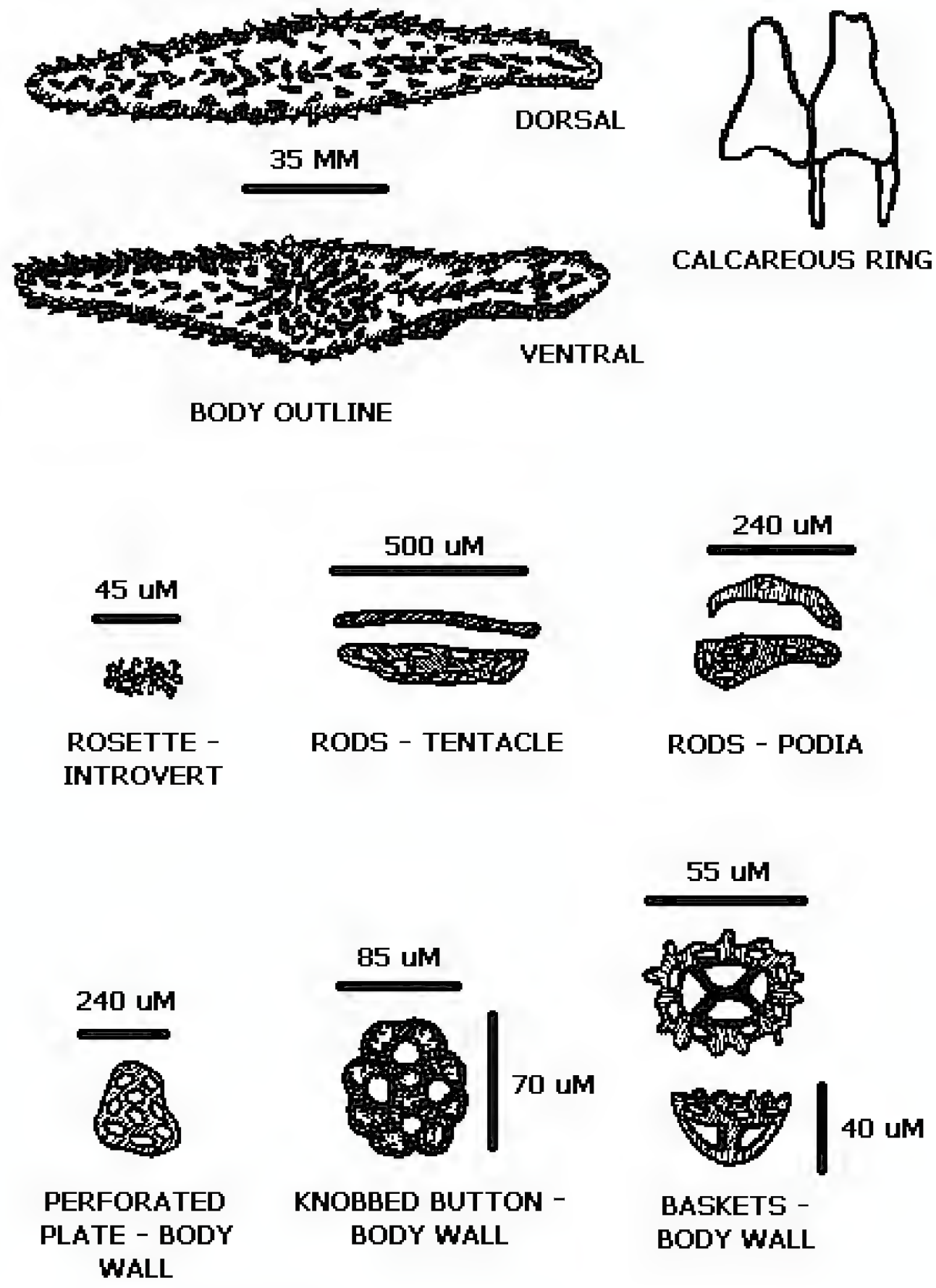


Figure 28. *Thyonella sabanillaensis.*

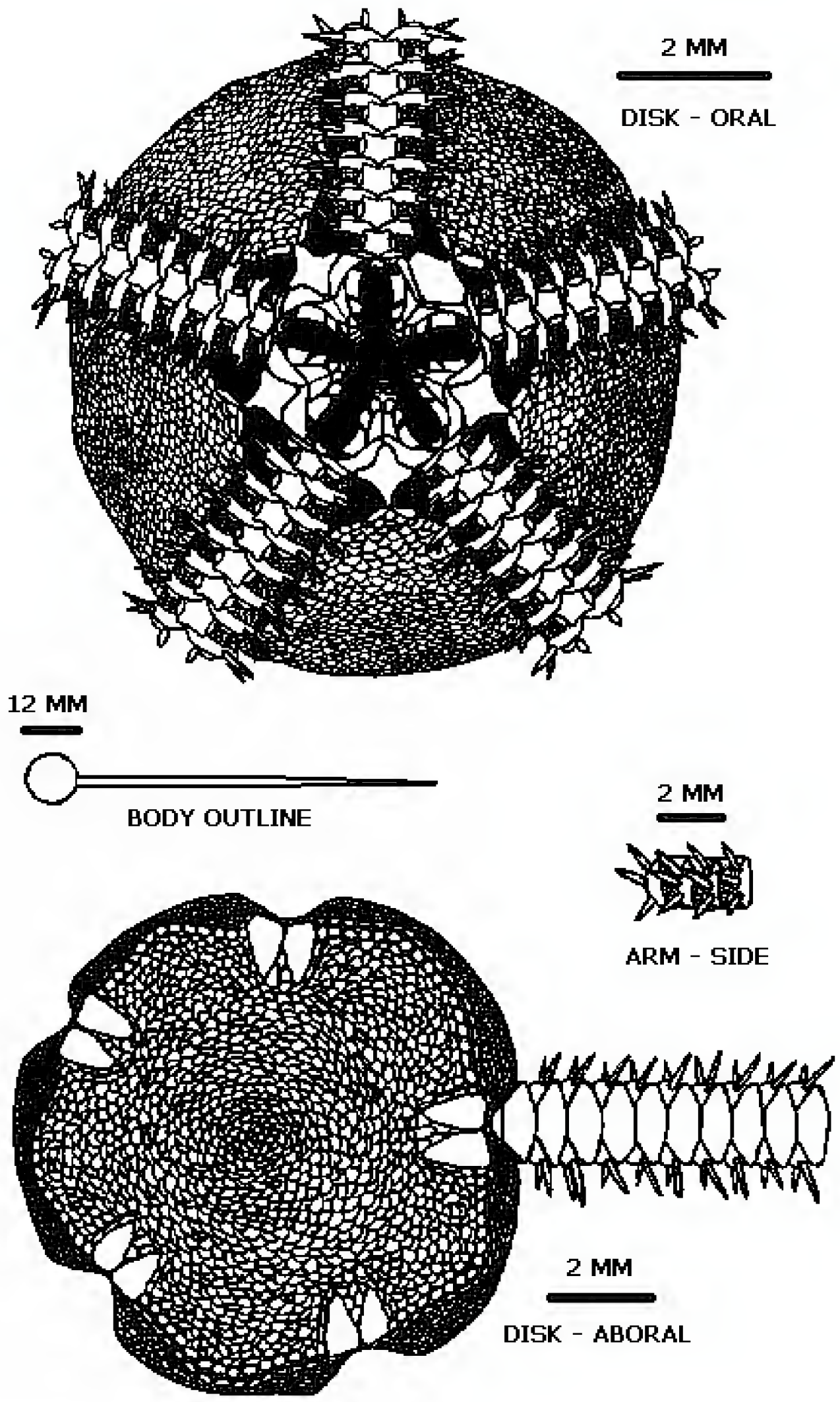


Figure 29. *Amphiodia atra.*

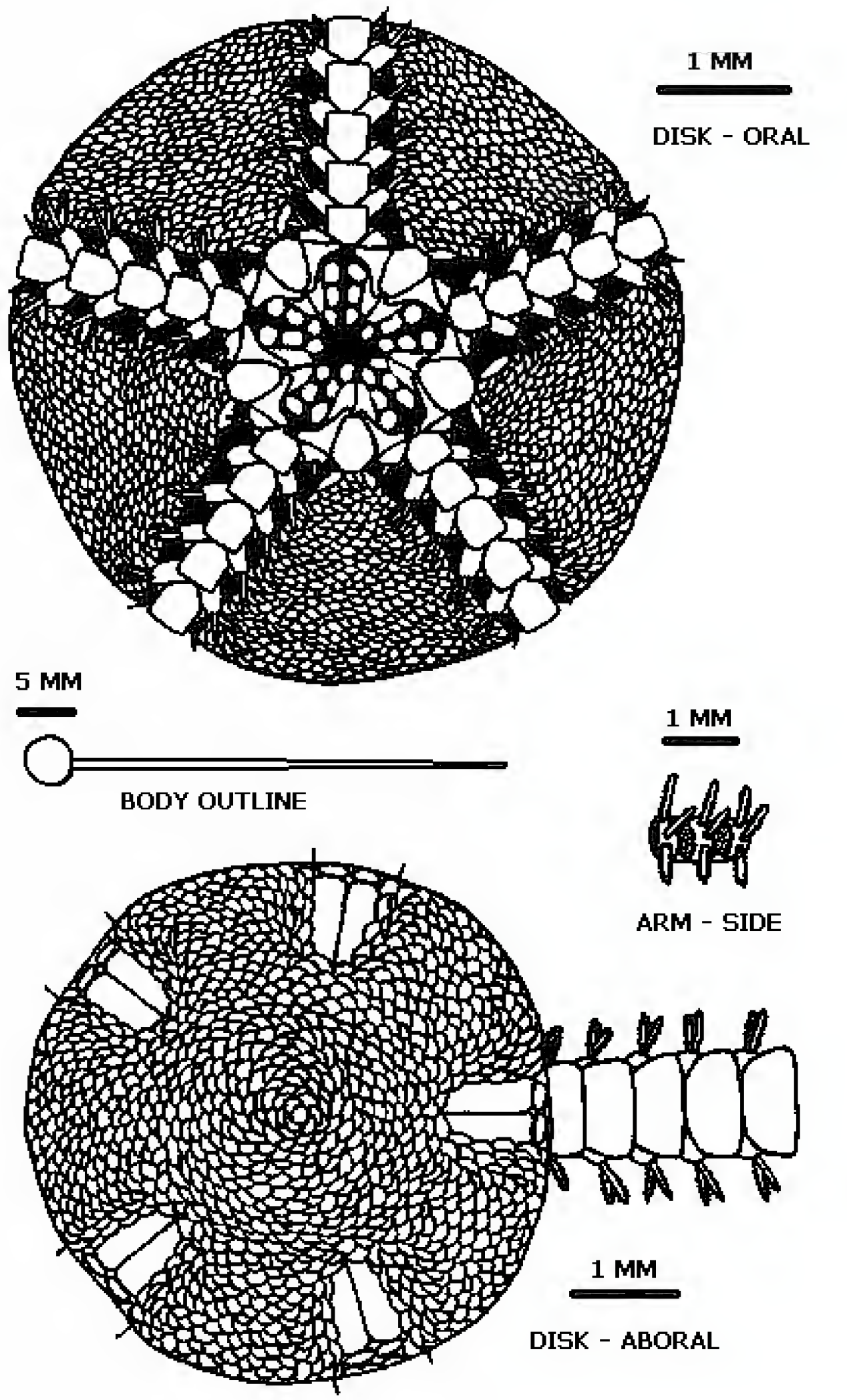


Figure 30. *Amphiodia pulchella.*

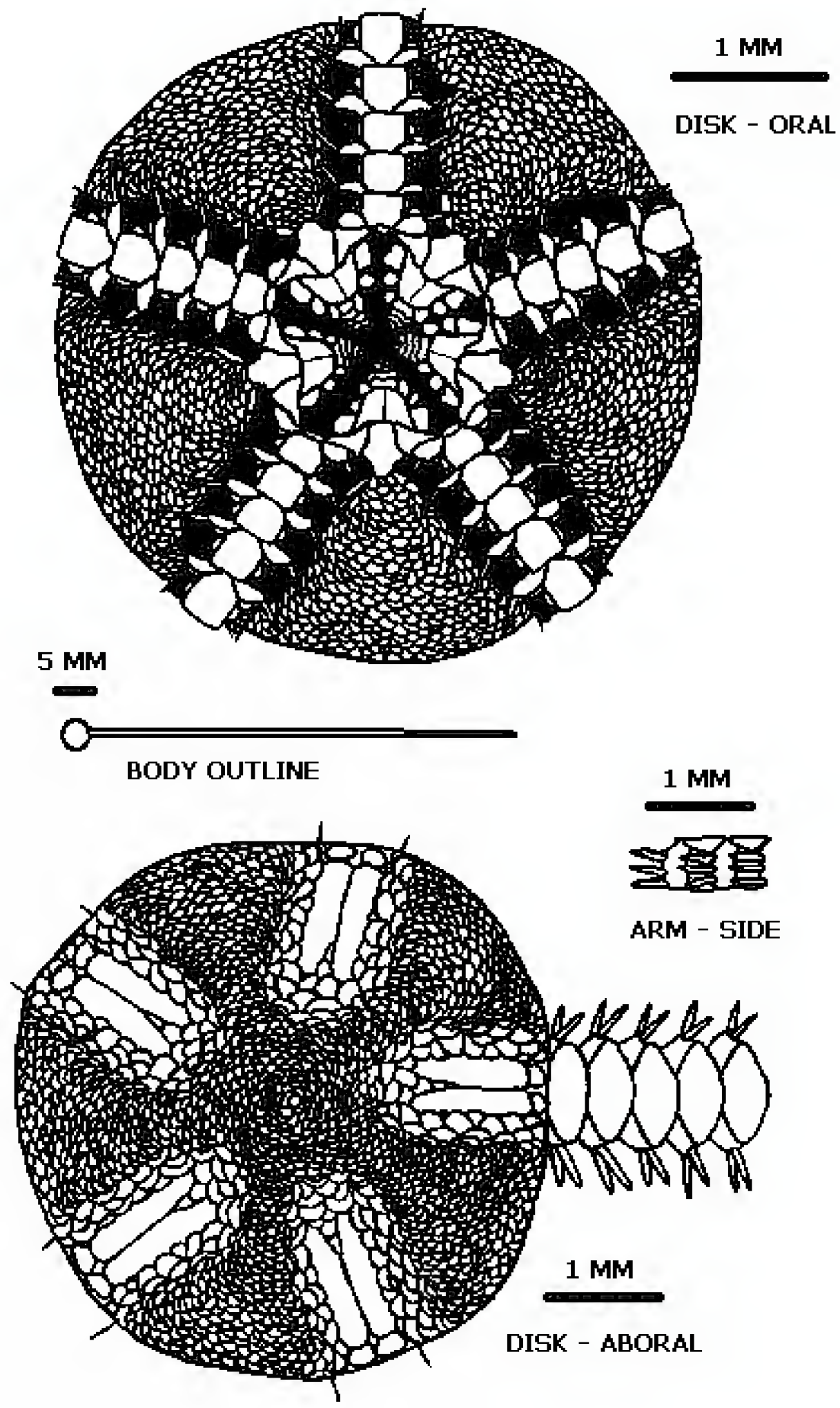


Figure 31. *Amphipholis gracillima.*

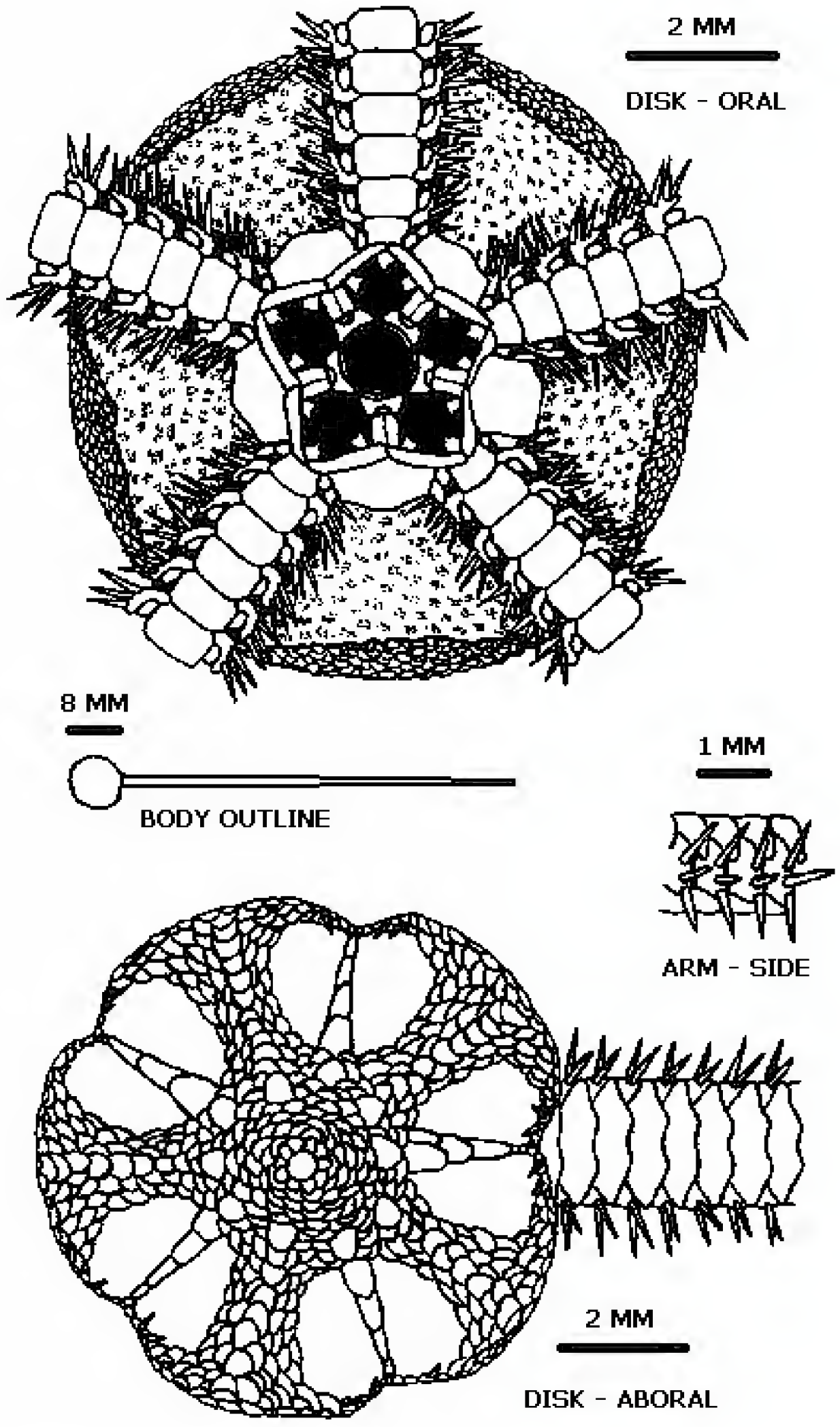


Figure 32. *Hemipholis elongata.*

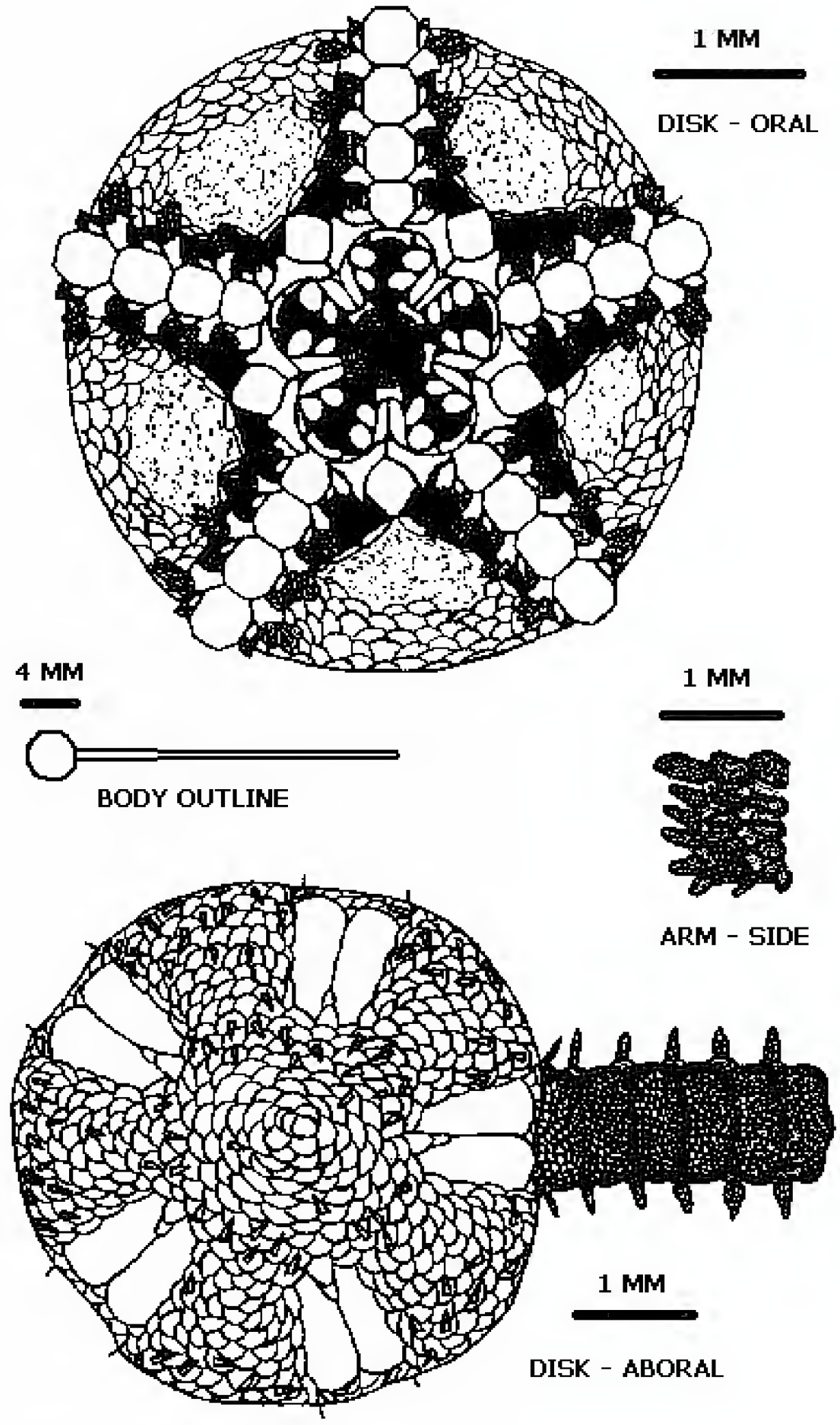


Figure 33. *Ophiactis savignyi.*

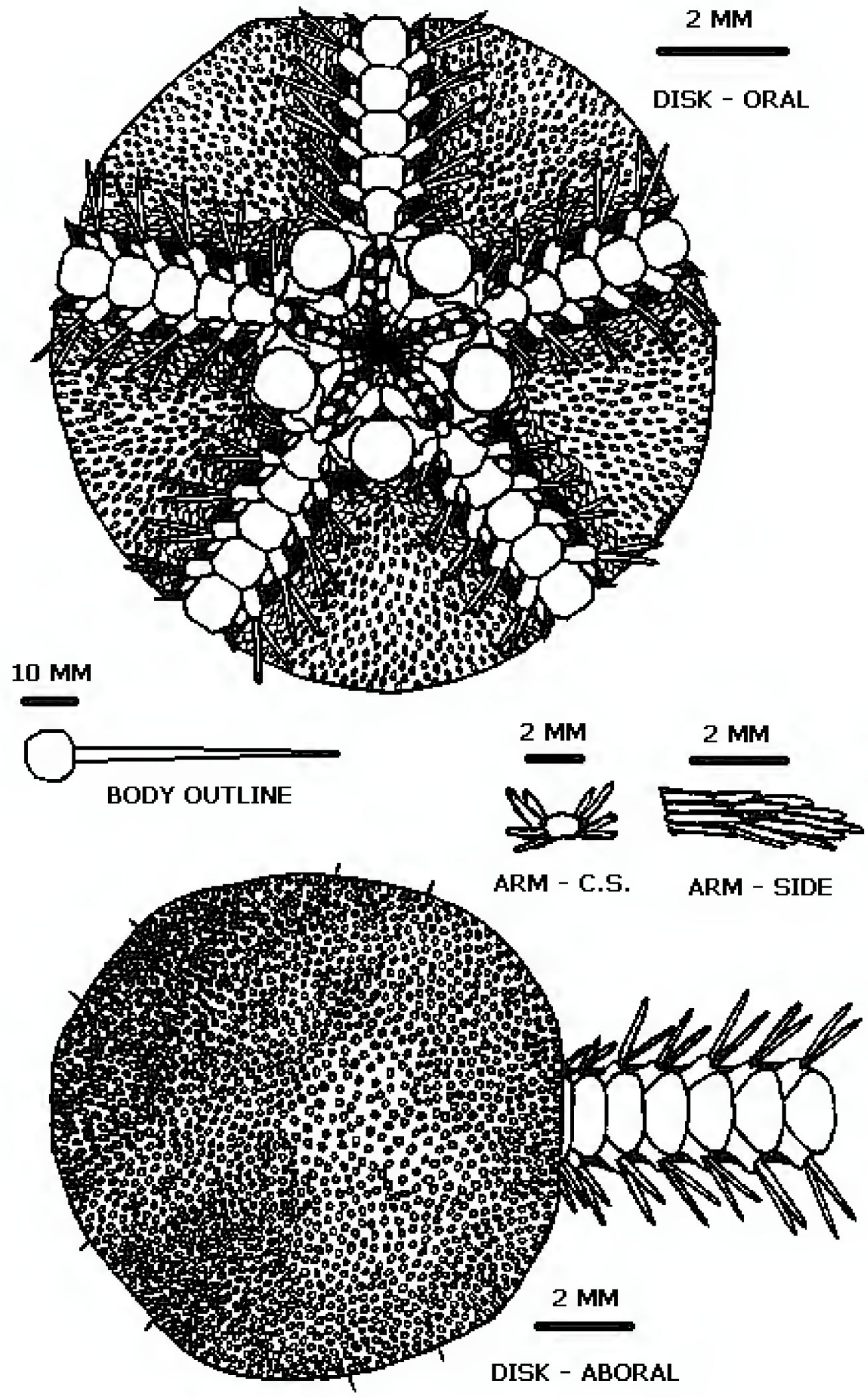


Figure 34. *Ophiocoma pumila.*

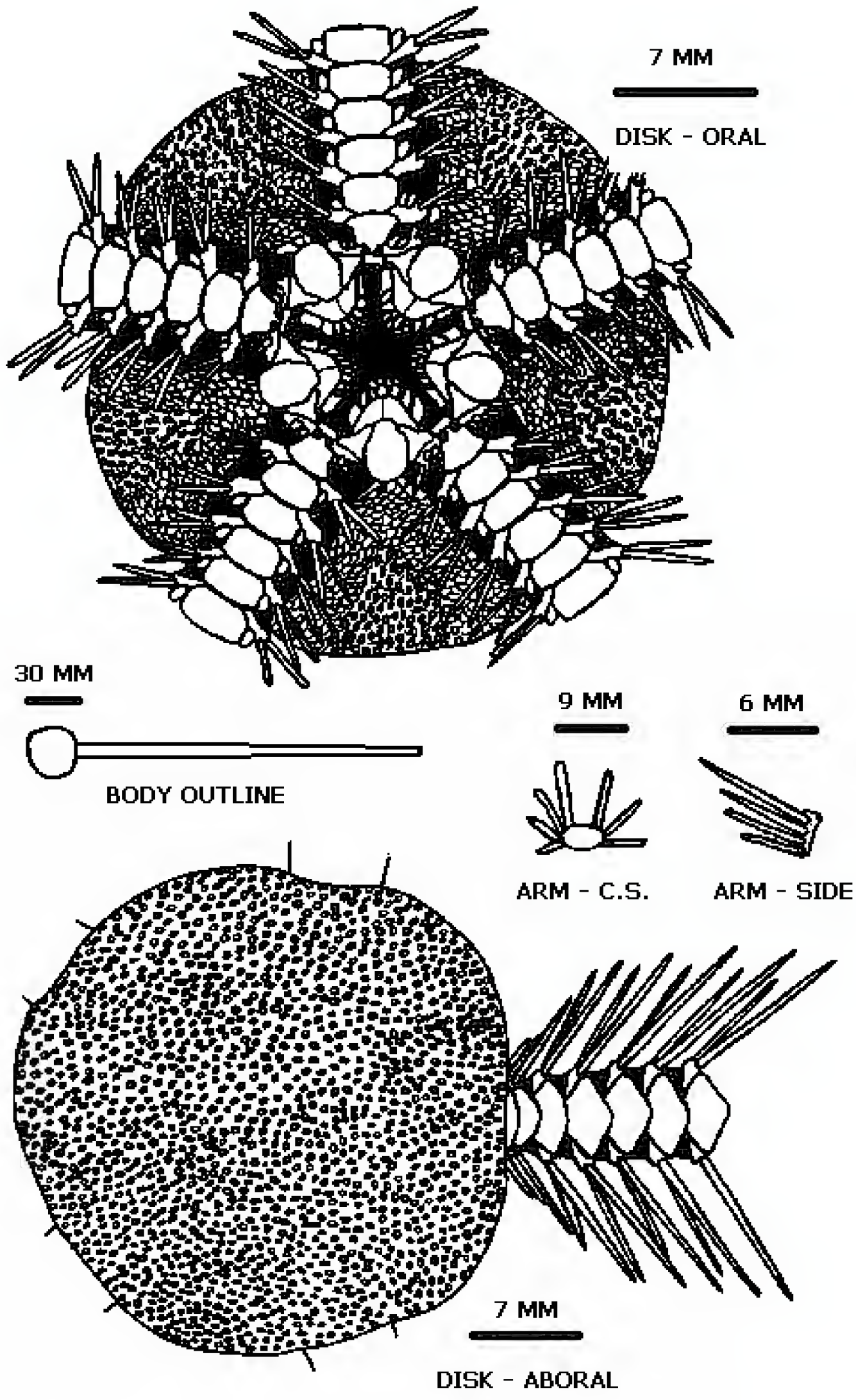


Figure 35. *Ophiocoma wendtii.*

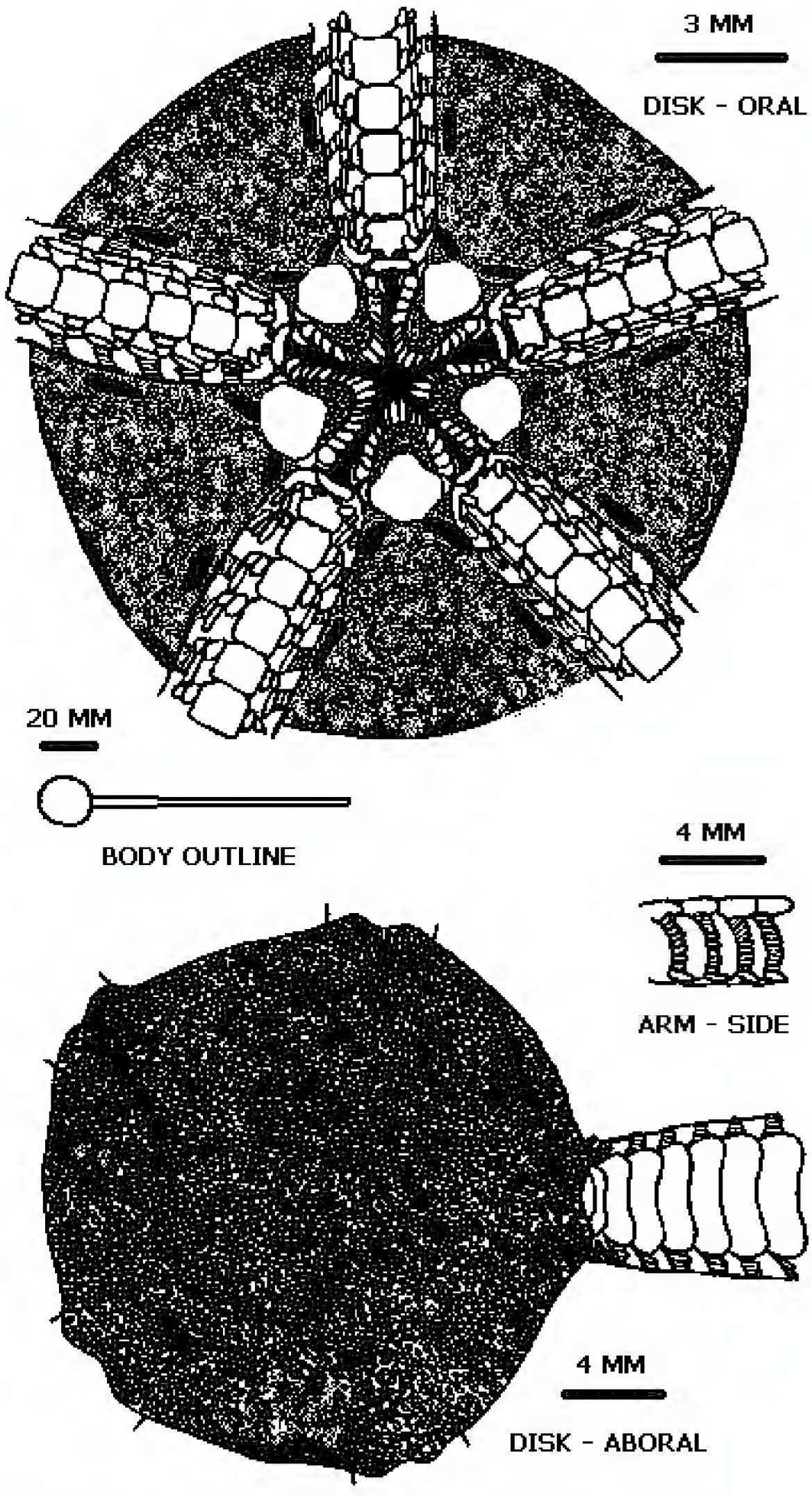


Figure 36. *Ophioderma appressum.*

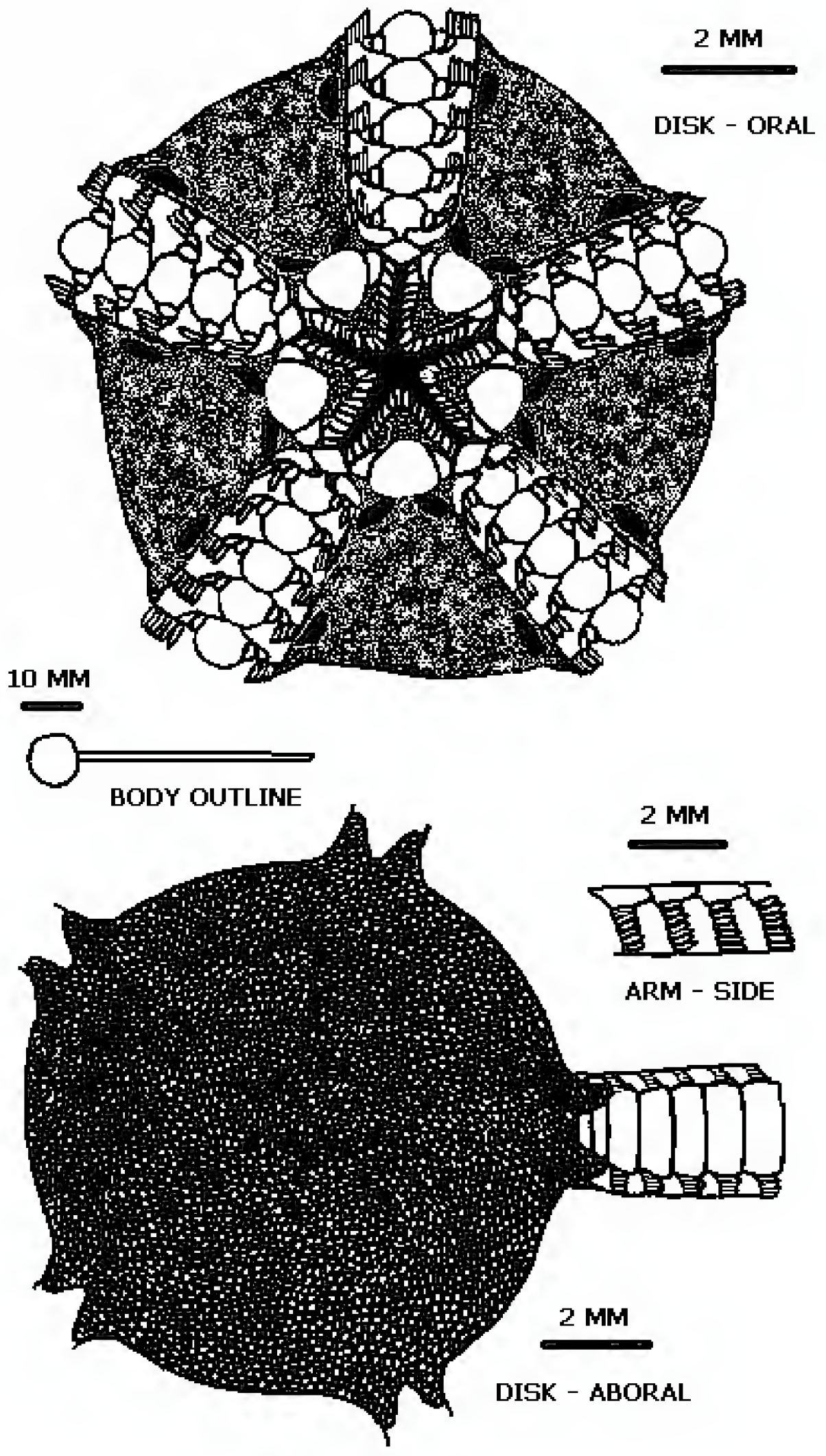


Figure 37. *Ophioderma brevispinum.*

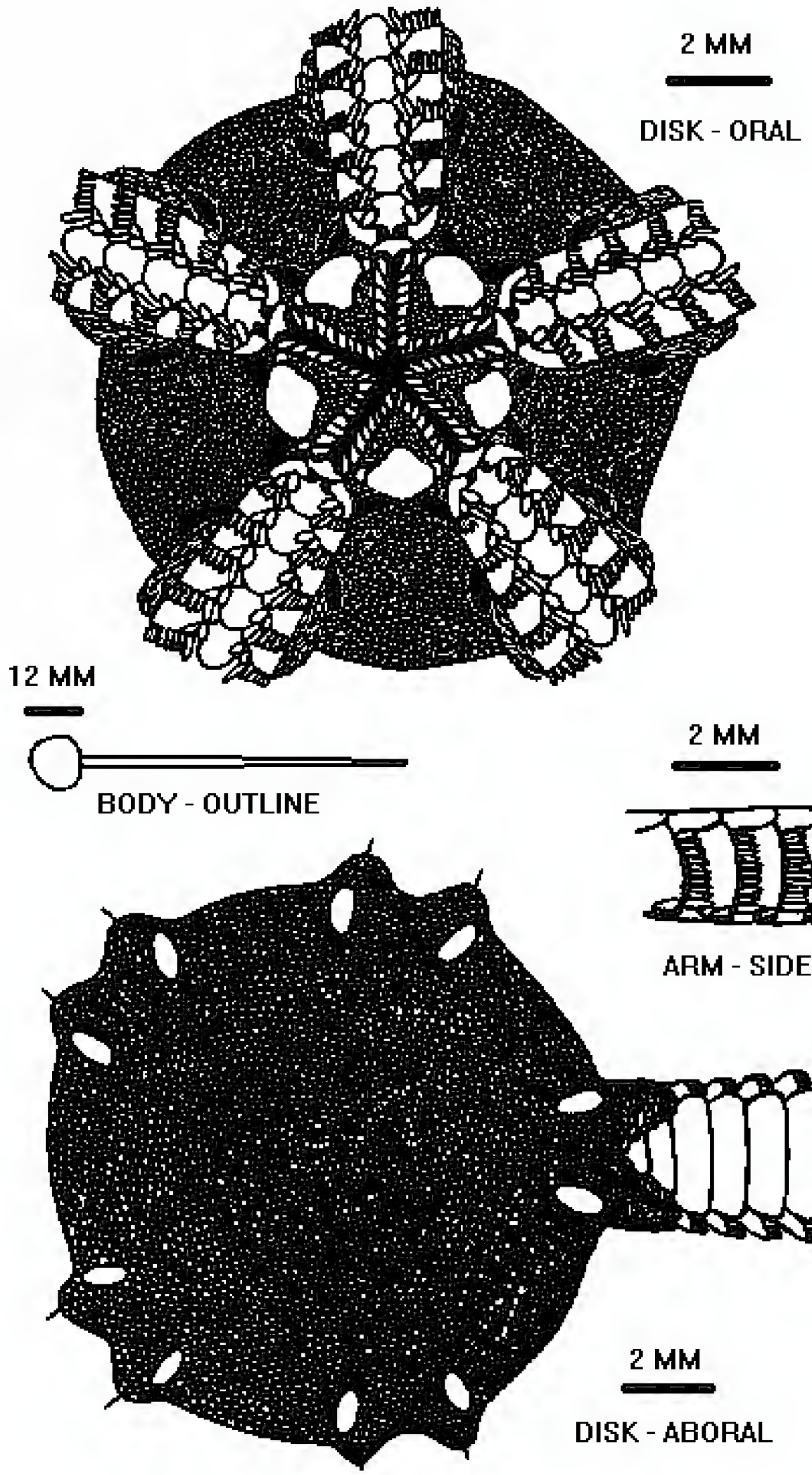


Figure 38. *Ophioderma rubicundum.*

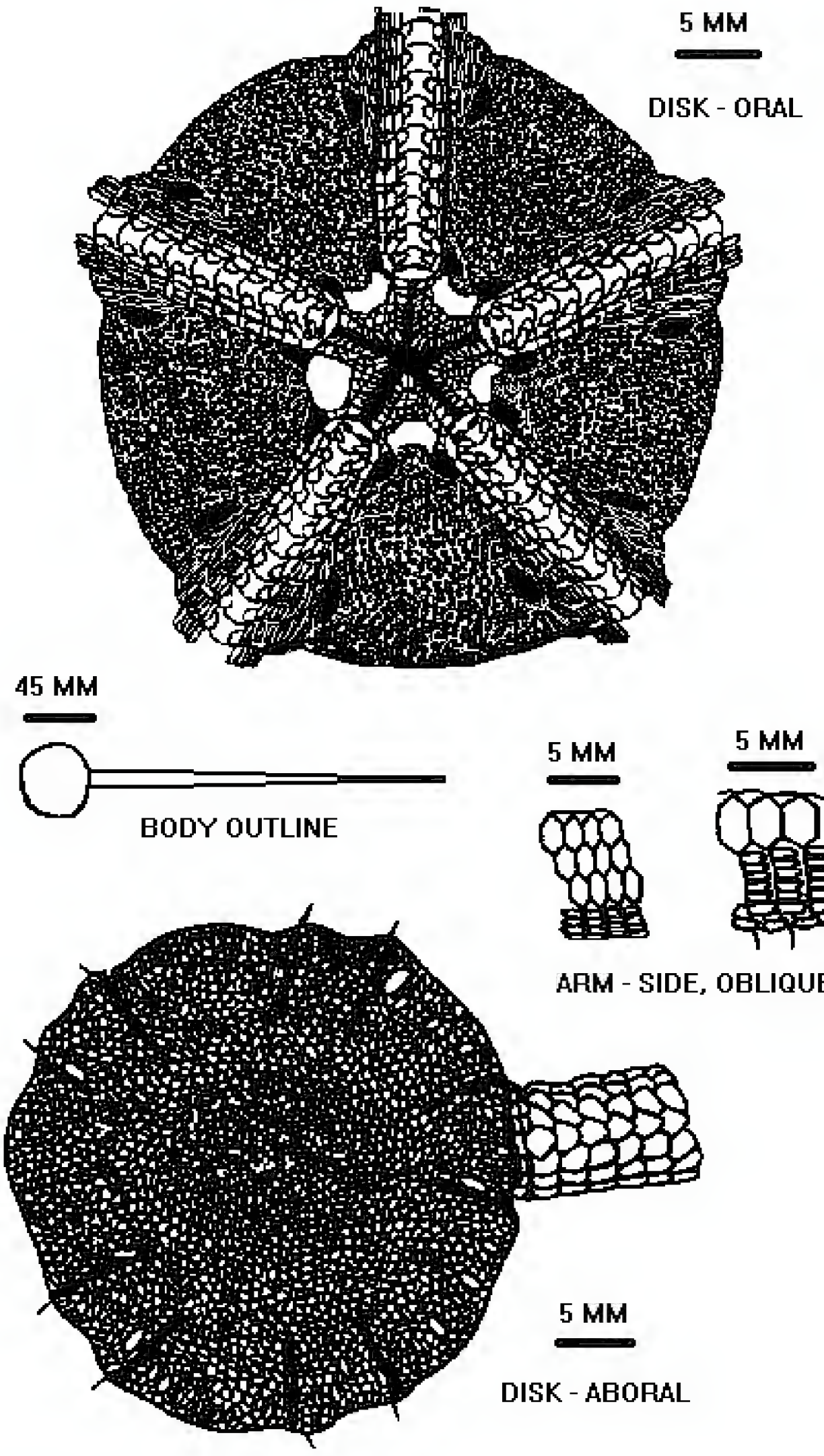


Figure 39. *Ophioderma squamosissimum.*

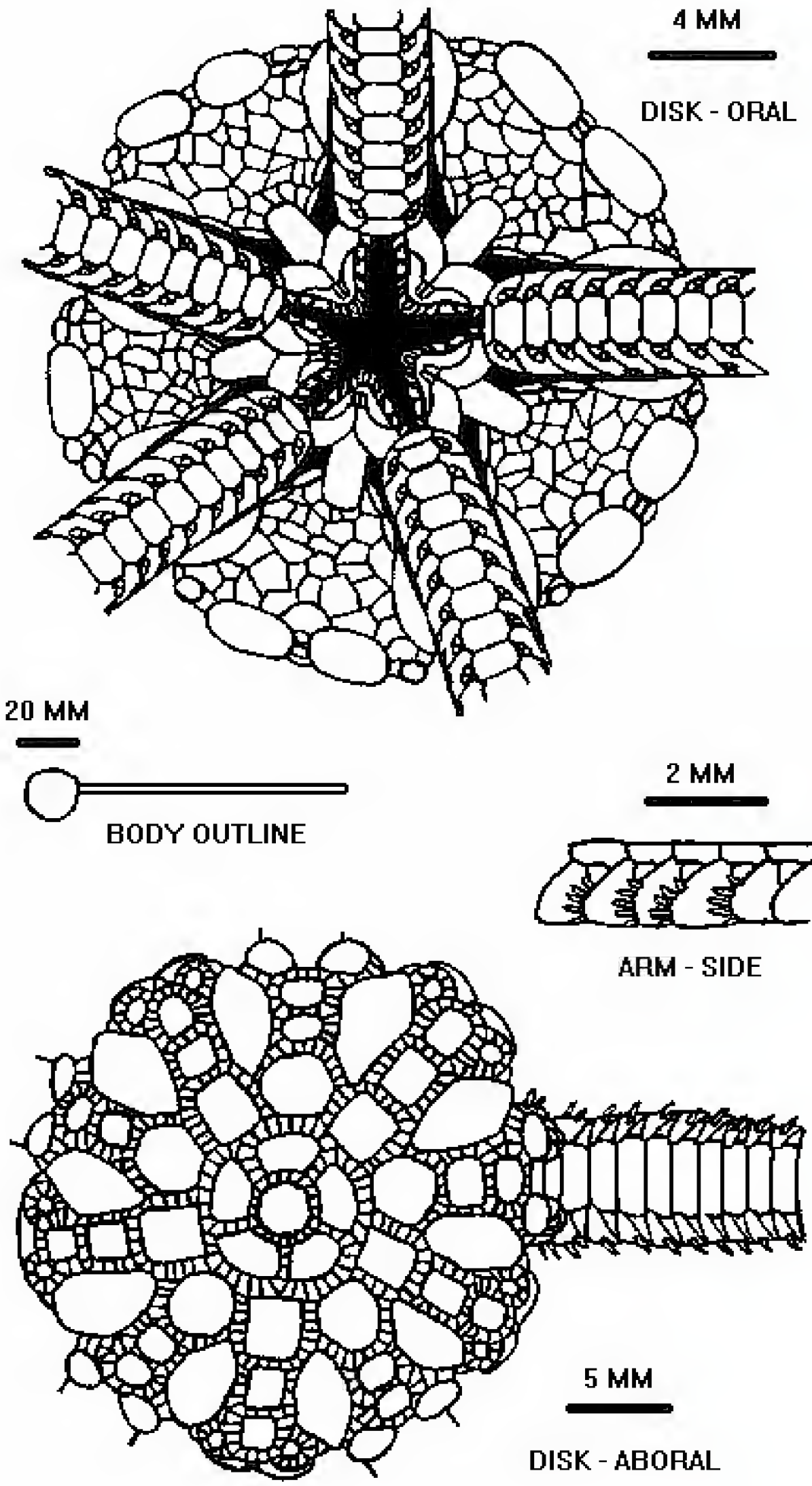


Figure 40. *Ophiolepis elegans.*

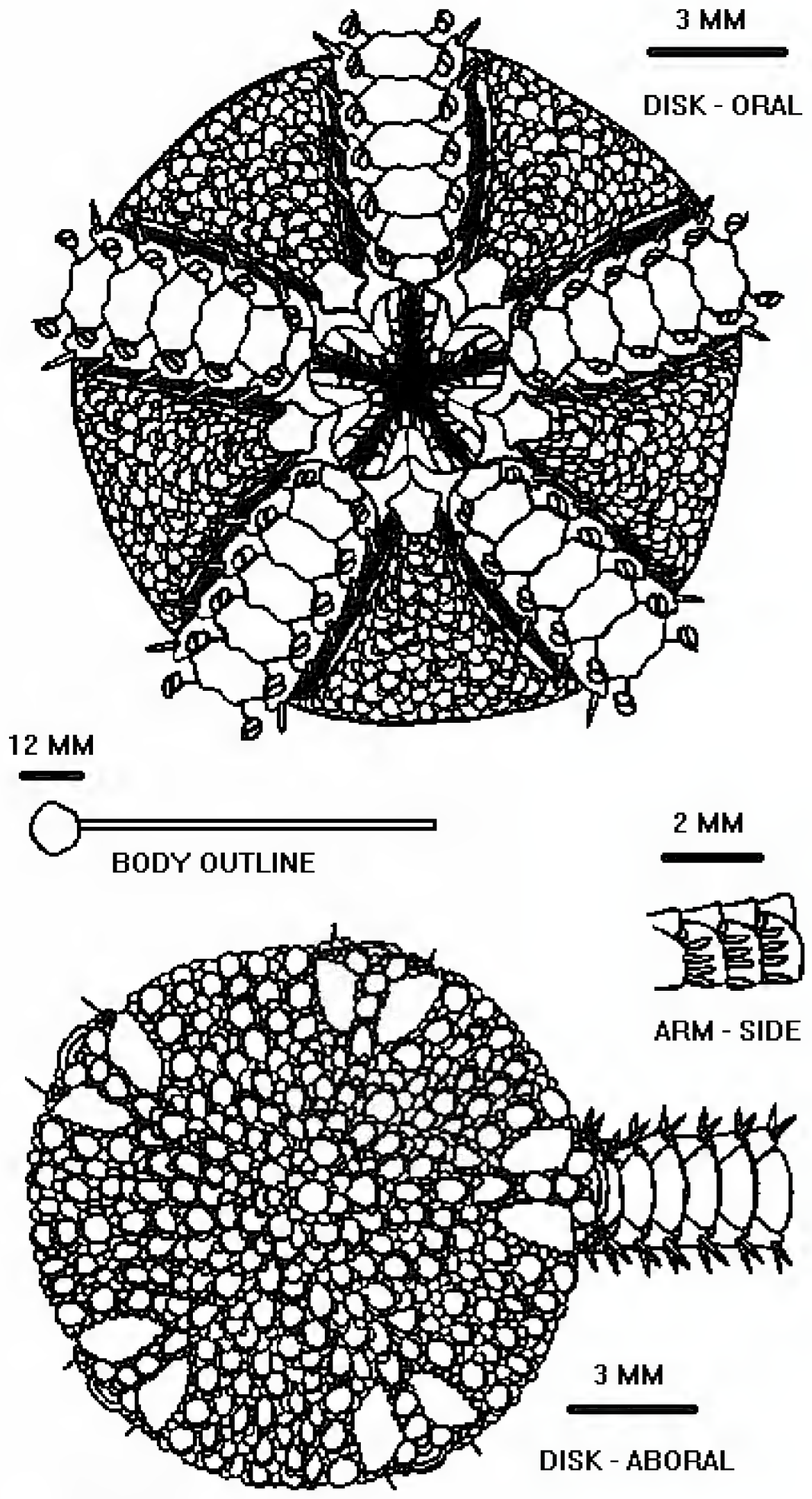


Figure 41. *Ophiolepis impressa.*

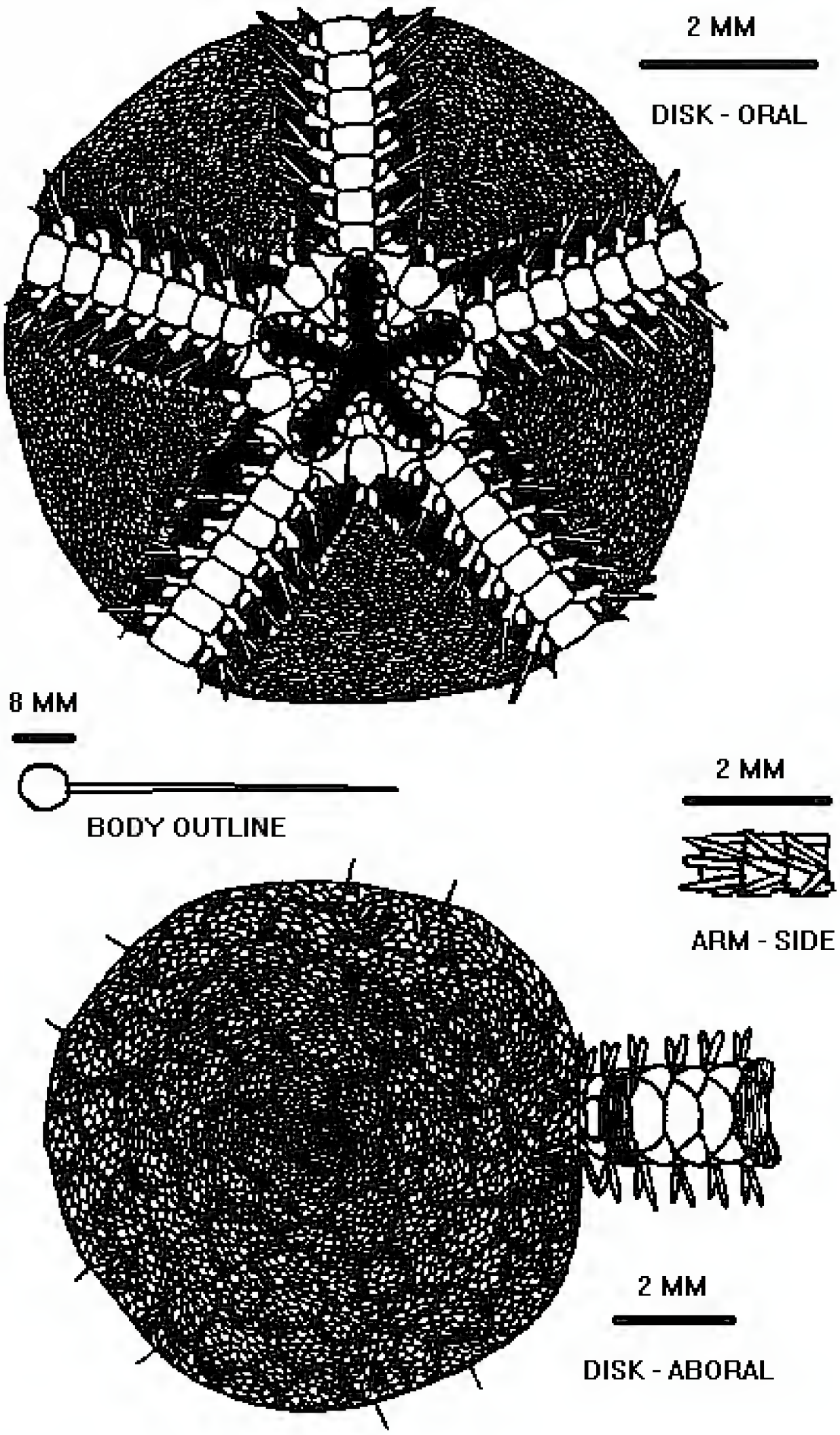


Figure 42. *Ophionereis reticulata.*

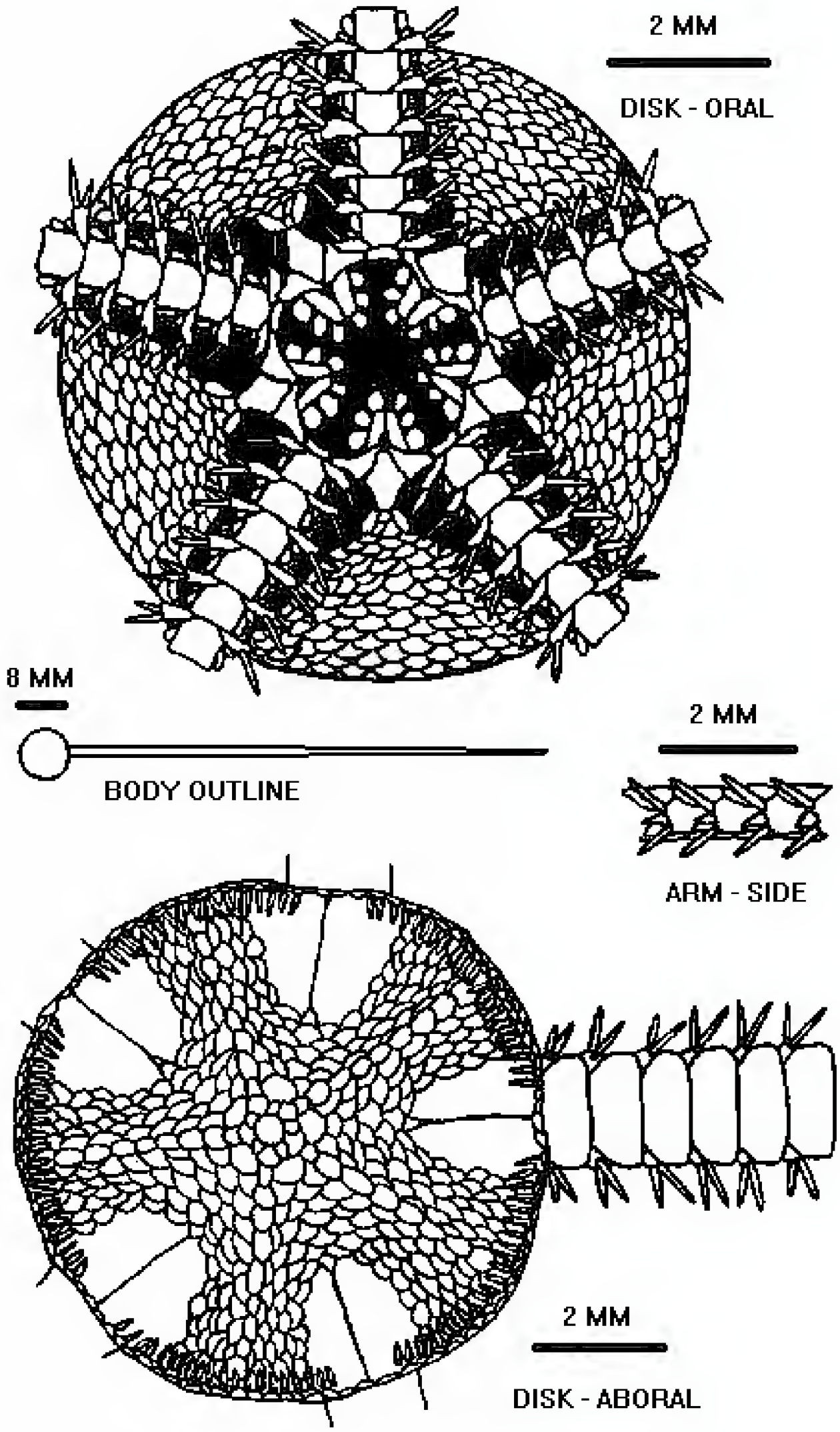


Figure 43. *Ophiophragmus moorei.*

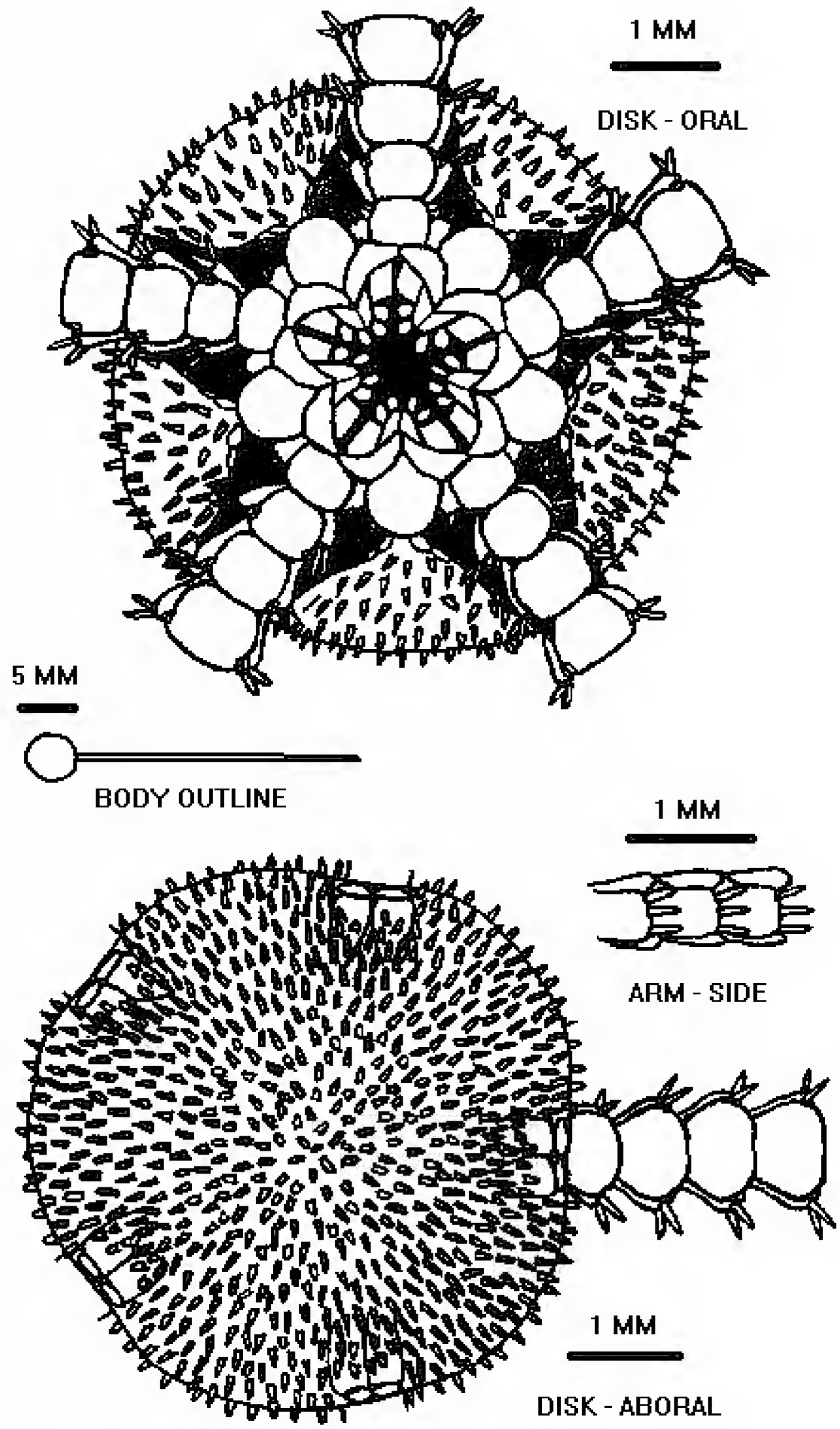


Figure 44. *Ophiostigma isocanthum.*

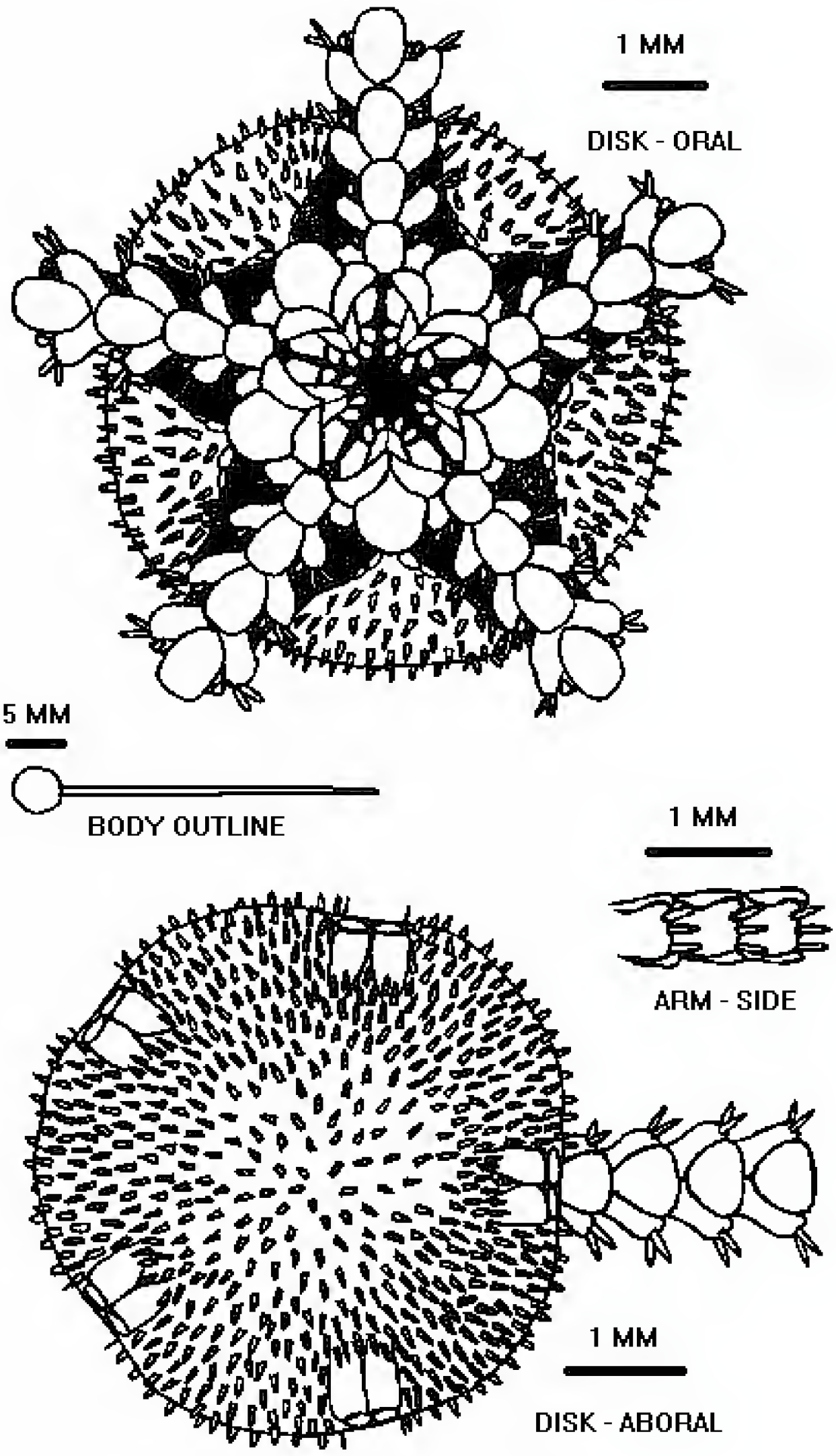


Figure 45. *Ophiostigma siva.*

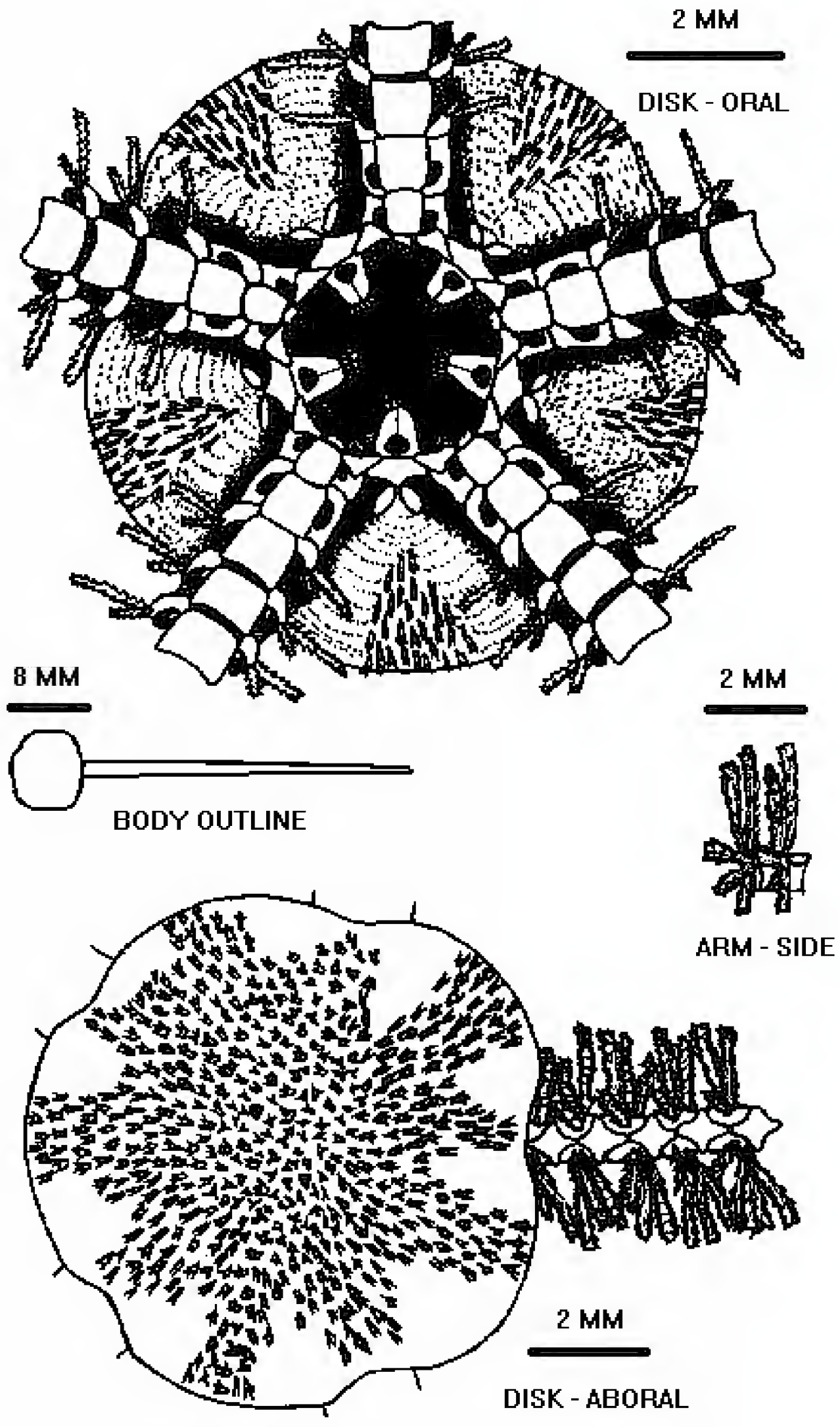


Figure 46. *Ophiothrix (Ophiothrix) angulata.*

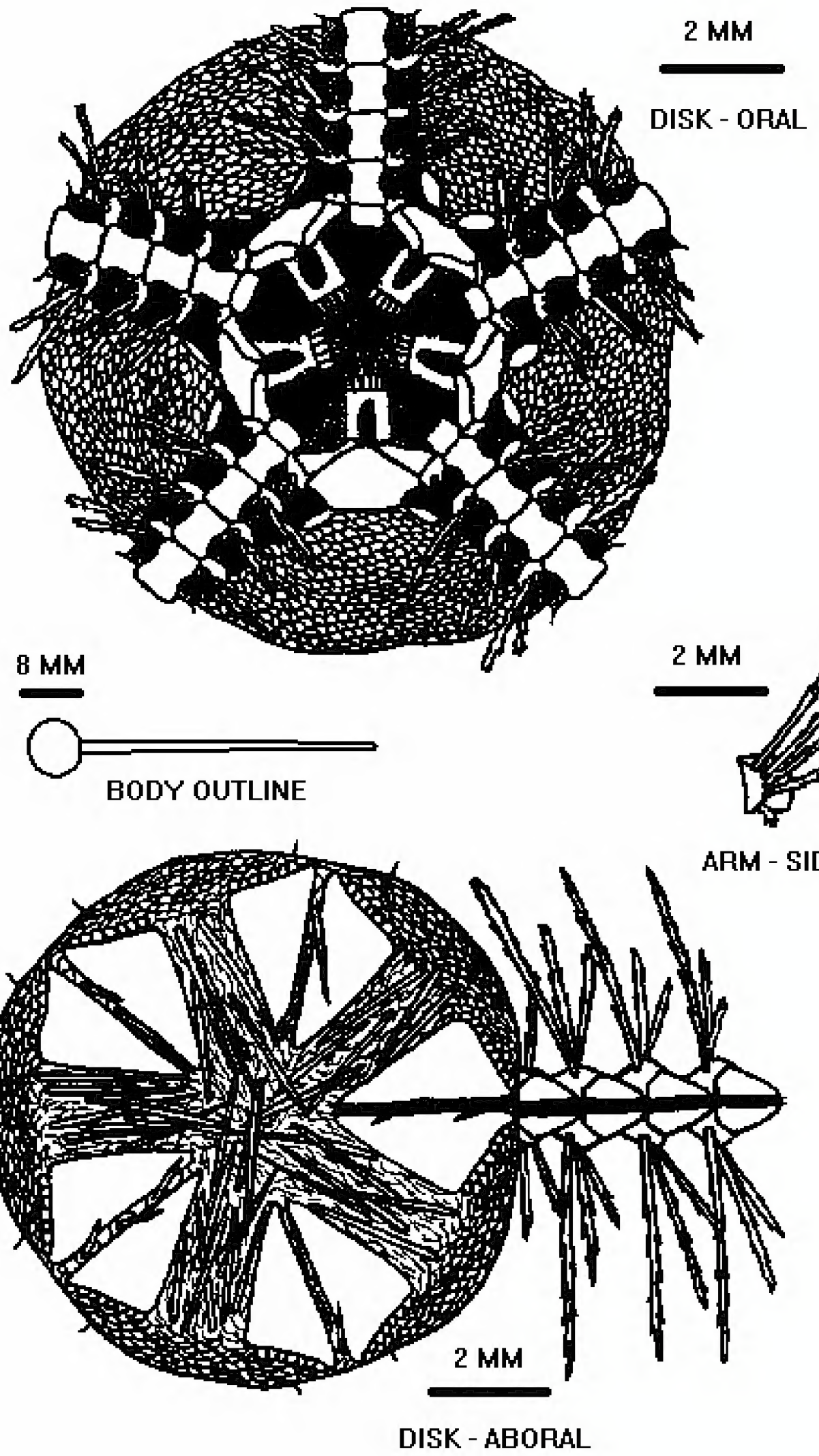


Figure 47. *Ophiothrix (Acanthophiothrix) suensonii.*

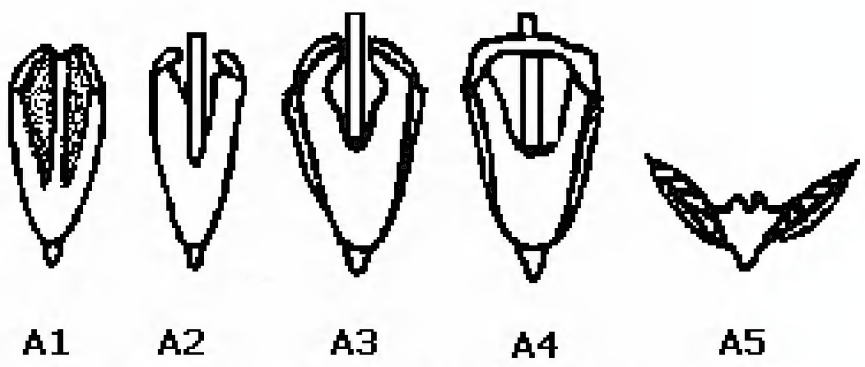


Figure 48. Characteristics of echinoids.

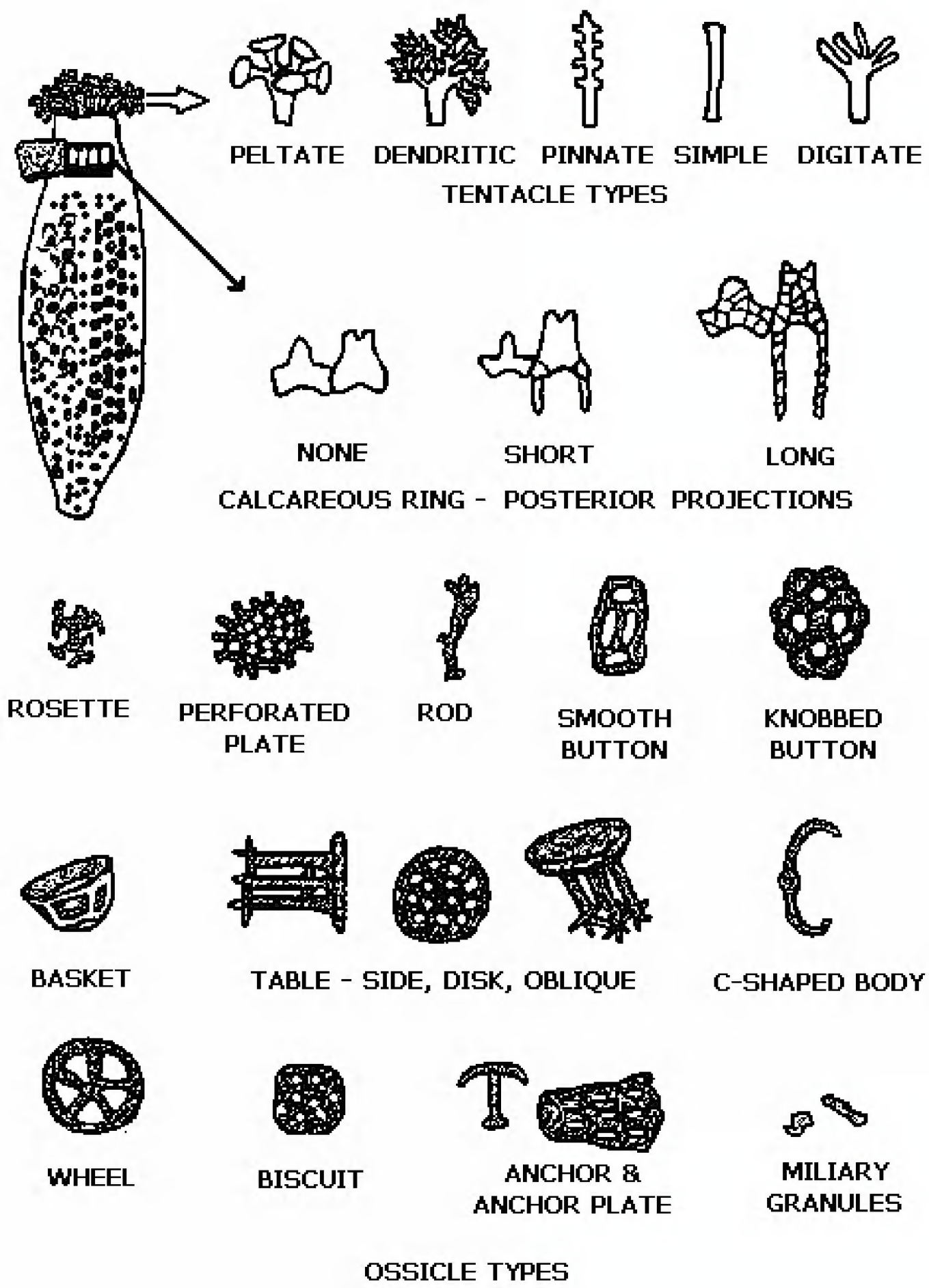


Figure 49. Characteristics of holothuroids.

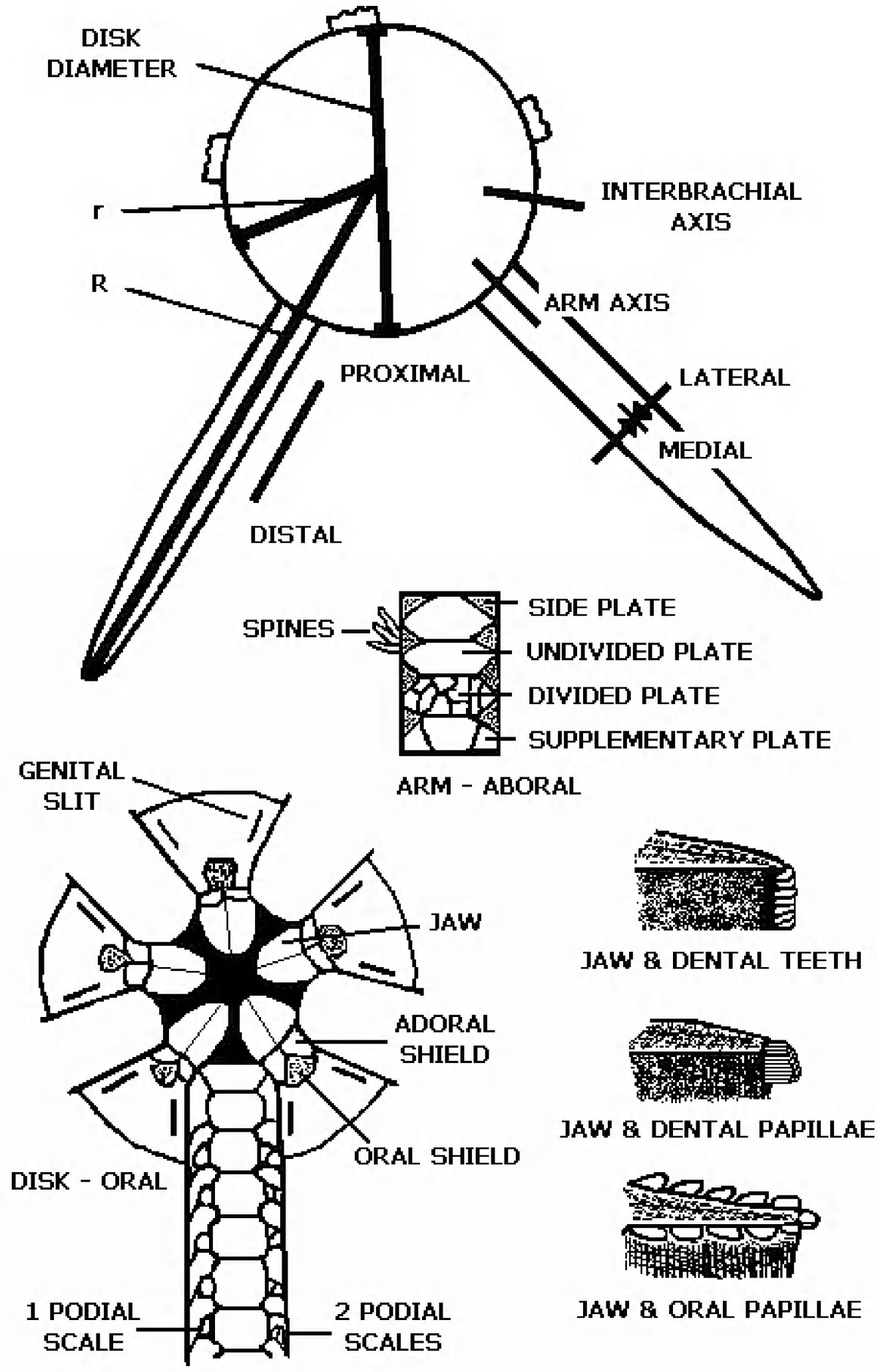


Figure 50. Characteristics of ophiuroids.